VOLUME XXI JANUARY, 1938 NUMBER 1

JOURNAL OF DAIRY SCIENCE

PUBLISHED BY THE
AMERICAN DAIRY SCIENCE ASSOCIATION

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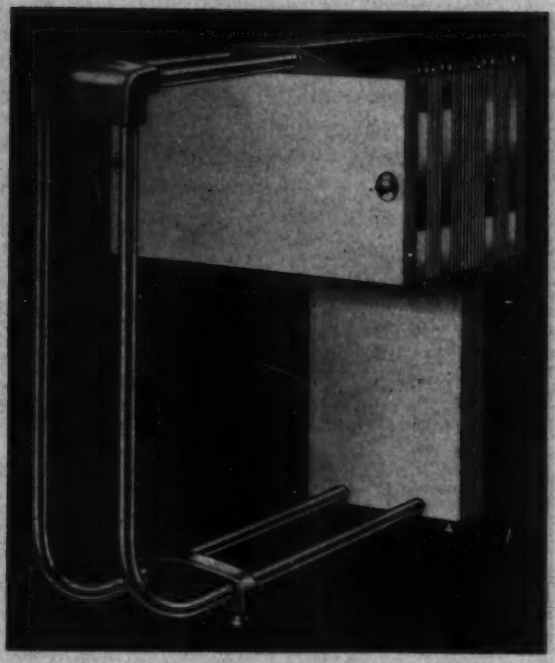

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JOURNAL OF DAIRY SCIENCE

VOLUME XXI JANUARY, 1938 NUMBER 1

A TEST FOR EXTRANEOUS MATTER IN CHEESE

D. W. SPICER[1] AND WALTER V. PRICE

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The requirements of the Federal Food and Drug Administration have stimulated the interest of the cheese industry in methods of detecting extraneous matter in cheese. Greene[2] has described a method which works well on some types but is somewhat slow in dissolving hard and semi-hard types of cheese. A satisfactory sediment test should make it possible to remove foreign material from American or Brick cheese without altering materially the physical condition and appearance of the extraneous matter which might be in it. Such a test to be of value in practical control work should be effective with cheese two weeks old. Rapidity and ease of performing the test and low cost of materials and equipment are highly desirable. This study was undertaken to attempt the development of a test with these characteristics.

First, it was necessary to determine the influence of the size of cheese particles, the type of filter, speed and type of agitation of the cheese with the solvent, type of solvent, concentration of solvent, temperature and time of exposure to solvent action, and the age of the cheese. Finally, after the most suitable conditions and solvents for cheese dispersion were determined, various materials which might possibly contaminate cheese were subjected to these treatments. Some of the substances exposed to such treatments were flies, cockroaches, human hairs, cow hairs, broom splints, brush hairs, cloth, copper and wood splinters. Many of the solvents were eliminated because of their effect upon foreign material.

The size of the cheese particles was varied from ¼-inch cubes to the mass resulting from the use of a regular meat grinder. A kitchen type food grinder eventually proved most satisfactory for macerating the cheese. The knife was removed from the grinder so that the cheese was simply forced or crushed through the perforated end plate. Foreign material retained its identity when this method was used.

Received for publication August 11, 1937.

[1] Industrial Fellow on a grant of the Kraft-Phenix Cheese Corporation.

[2] Greene, W. S. A method for the detection of extraneous matter in cheese. Cheese Reporter. March 21, 1936.

Mixtures of cheese and various solvents were stirred in one quart milk bottles with an ordinary laboratory electric mixer equipped with a bent glass stirring rod. The speed of the mixer could be adjusted but for ordinary use the revolutions per minute approximated 1000. It was desirable to place a guard plate on the stirring rod to protect the open mouth of the milk bottle from oil or dust from the mechanical stirrer.

Several kinds of filter papers, cloths and ordinary milk sediment discs were used for removing sediment from the solutions of cheese. The regular milk sediment discs proved most satisfactory for filtering but not so good for examining the sediment because foreign material tended to become imbedded and hidden in the cotton fibers and because under the microscope the fibers of the pad could be confused with white hairs. These objections were minimized by reversing the filter pads, so that the sediment was left on the compact side of the pad and remained clearly visible.

The filter pads were used in both a vacuum milk sediment tester and a pressure milk sediment tester. The vacuum tester usually left a small amount of the solution on the pad. Before the pad could be removed from the tester this small amount of solution had to be poured or washed off, and frequently this lost some of the sediment. It was also difficult to wash the pad of the vacuum tester with hot water in order to remove undissolved fat. The pressure type of milk sediment tester proved to be most suitable. Light pressure from the laboratory air line instead of the usual rubber bulb was used to force the liquid through the filter. This was very convenient when a large number of samples were tested, but the rubber bulb was just as effective.

It was difficult to find a solvent that would release insoluble material in the cheese without changing the physical characteristics of the foreign material. Various concentrations and combinations of a number of chemicals were tried. Concentrations were varied from about 0.25 per cent to 20 per cent while temperatures of heating were varied from 20° to 100° C. and maintained from 10 minutes to 18 hours. Each solvent seemed to produce its best action on cheese under certain optimum conditions of concentrations, temperature and duration of contact with the cheese. These optimum conditions were determined by repeated trials and then the various solvents were compared. All solvents were criticized for their action on cheese, action on foreign material, speed of solution, ease of filtration, and undesirable residue left on the pad. The following solvents and combinations of solvents dissolved cheese efficiently when used under the proper conditions: Minnesota-Babcock reagent; sodium bicarbonate; sodium hydroxide; di-sodium phosphate; tri-sodium phosphate; hydrochloric acid; sodium citrate; tetra-sodium phosphate; tri-sodium phosphate and di-sodium phosphate; and sodium citrate and hydrochloric acid. Commercial pepsin was also tried but was too slow in action to be practical. It is not necessary here to

discuss the specific effects of all of these substances. Solvents which seemed most desirable in several respects failed to satisfy in some other manner. For example, it was found that Minnesota reagent and concentrated hydrochloric acid discolored the cheese and sediment pad, while solutions of cheese made with sodium hydroxide filtered in a satisfactory manner but tended to decompose foreign material.

The most satisfactory solvent was found to be 150 grams of sodium citrate dissolved and diluted in distilled water to 1000 ml. The use of a small amount of hydrochloric acid with the sodium citrate frequently hastened solution but was undesirable because sometimes the solvent mixture formed a slime which delayed filtration. This sodium citrate solution can be used on the common varieties of cheese. In the course of this study it was used on the edible portions of Swiss, American, Brick, Limburger and Cream cheese. The rind on Limburger, which is sometimes eaten, would not always dissolve in a satisfactory manner with the sodium citrate solution.

The age of the cheese affects the ease of solution. Old cheese disintegrates more easily than fresh cheese. Trials with freshly made Brick and American cheese indicated that prolonging the exposure of the cheese to the solvent accomplished the desired results. Cheese was soaked at 37° C. for 18 hours in this solvent without affecting the common types of extraneous matter which might contaminate it. More than 200 samples of Brick cheese, collected over an eight months' period from 40 different factories, dissolved readily in the sodium citrate solution. In not more than 15 instances was a 30 minutes' exposure to the solvent inadequate.

The details of the procedure which was finally adopted to determine the extraneous matter in the cheese are presented here.

PROCEDURE FOR DETECTING EXTRANEOUS MATTER IN CHEESE

The equipment and materials for making the test consist of a meat grinder; torsion balance capable of weighing 100 grams; clean 200 cc. beakers; clean quart milk bottles; parchment paper; cheese knife; adjustable speed, electric stirrer; water bath; sediment tester discs; pressure sediment tester; hot plate or Bunsen burner; and a wash-bottle for distilled water. The solvent solution is made by dissolving 150 grams of sodium citrate in distilled water and then diluting the solution to 1000 ml. The solution is always filtered before use.

The cheese is prepared for analysis by placing it on clean parchment paper, removing the rind with a knife, and cutting the cheese into strips of suitable size to feed into the food chopper. Extreme care must be taken to keep particles of paraffin or dust specks out of the sample. The grinder must be clean and free from rust and sediment. The cutting knife should be removed so that the cheese is only forced through the usual perforated end plate of the food grinder. The crushed cheese is collected in a clean 200

cc. beaker. After each sample is ground, the machine must be cleaned by washing.

Exactly 100 grams of the crushed cheese is weighed into a clean quart milk bottle which has been thoroughly washed and rinsed with distilled or filtered water. Then 200 ml. of the filtered solvent solution is added to the sample of cheese and the milk bottle is placed in the water bath at 61.7° C. (140° F.). At higher temperatures protein material tends to coagulate and produces slime which clogs the filter pad.

The mechanical agitator is adjusted in the bottle and the mixture stirred at approximately 1000 r.p.m. for 15 minutes. A 100 cc. portion of distilled water and 100 cc. of the solvent solution are then added and the mixture is again agitated, this time until the cheese particles are entirely dissolved. Ordinarily not more than 30 minutes will be required to accomplish this dispersion. The contents of the milk bottle are then divided into two equal parts and each part is filtered through a single sediment disc. The sediment discs are reversed in filtering so that the sediment remains on the compact surface. After each filtration the sediment tester must be thoroughly rinsed with distilled or filtered water so that all sediment will be on the pad.

One filter pad will usually accommodate the entire sample but in general it is advisable to divide the cheese solution into two equal parts and then pass each half through separate discs. Since 100 grams of cheese represent about one quart of milk, then each sediment disc resulting from this procedure contains the residue from a pint of milk and can, therefore, be compared with the standards used for judging sediment tests of whole milk.

Interpretation of the results of any sediment test must be somewhat arbitrary. Accepted standards for market milk may be applied when a sample of cheese weighing 50 grams is filtered through a single disc. In this study a low power binocular was used to identify extraneous material in cheese. Examinations of discs under 25X and 75X magnification were made as a matter of routine. It was convenient to classify the results of the tests as good, fair, unsatisfactory and bad. A good disc is practically clean to the eye and is microscopically free from material pertaining to animals and insects. A fair disc to the eye shows the presence of a small amount of sediment, but is microscopically free from material pertaining to animals and insects. An unsatisfactory disc to the eye shows the presence of an appreciable amount of sediment, but is microscopically free from material pertaining to animals and insects. A bad disc contains hairs or other materials pertaining to animals and insects.

PRACTICAL APPLICATION

Brick cheese was purchased from about 40 Brick cheese factories at intervals throughout the year, tested for extraneous matter and finally was scored at six weeks of age.

Table 1 shows the relation of sediment in cheese to the quality of the

TABLE 1

Relation of sediment to the grade of Brick cheese

SEDIMENT TEST	NUMBER OF SAMPLES	PER CENT OF SAMPLES	AVERAGE SCORE OF CHEESE
Good	7	5.88	89.7
Fair	56	47.06	89.4
Unsatisfactory	36	30.25	88.4
Bad	20	16.80	88.1

cheese. As the sediment in the cheese increased, the quality of the cheese decreased. Sediment is not the fundamental cause of poor cheese. Sediment is rather the evidence of improper production and manufacturing methods. Careful farmers and skillful cheese makers in their efforts to control the quality of milk and cheese protect these products from contamination. Their equipment is cleaner and their methods are more desirable than those of less careful producers and operators. Filters could remove extraneous matter without changing the quality of the cheese. Milk and cheese, however, should be clean without the use of filters.

This test has been adopted for use in at least one commercial laboratory, and for a period of more than a year has proved to be a satisfactory method of checking the cleanliness of production methods.

NATURE'S COMPENSATION FOR THE LOST QUARTER OF A COW'S UDDER

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In following the regular procedure of studying the structure of the cow's udder in relation to its comparative development in early life and its subsequent producing ability, the Bureau of Dairy Industry recently recorded a case that appears to throw some light on the question of whether or not Nature compensates for the loss of one or more quarters of the udder by increasing the activity of the remaining quarters. The case in question is that of cow No. 1074, a registered Jersey bred and raised in the Bureau's herd at the National Agricultural Research Center, Beltsville, Md.

The udder of this animal was examined periodically beginning at the age of 1 month 26 days, according to the program regularly followed with all heifers in the breeding herd. The notes recorded at the different observations up to 11 months 28 days of age include nothing to suggest any deficiency or abnormality in the quantity or form of glandular tissue in the udder. In fact, at each of these observations excepting the first, the mammary gland development appears to have been well above the average. At the observation made at the age of 1 year 5 months 22 days, however, the udder was poorly shaped, and the glandular development was definitely below average for length, width, and depth excepting for the right rear quarter which showed an abnormal enlargement and contained a large, round, non-compressible, hard lump about 2¾ inches in diameter. The cause of this condition is not known. Apparently the more or less acute condition described disappeared during the following months as there is nothing in the record of the four observations taken during the two months before calving to indicate any lack of uniformity or any deficiency in the udder.

At the observation made on May 10, 1934, two days after calving, the swelling incidental to parturition was extreme, and the udder was definitely plastic especially in the rear. The term "plastic" is used to mean that localized external pressure leaves a persistent indentation. The notes recorded on that date, however, show that the left rear quarter was "blind," the right rear quarter contained a little fluid, and the left front quarter was below normal in fullness. The left rear quarter declined in size more rapidly than the others, though the udder was not markedly unbalanced, and the "feel" of the front and rear quarters did not differ greatly. Notes recorded

Received for publication August 12, 1937.

[1] Resigned May 31, 1937.

on July 12, 1934, show "both rear quarters blind." This cow, therefore, came into milk with the left rear quarter entirely inactive and the right rear quarter yielding only a little fluid, and both rear quarters were "blind" almost from the commencement of lactation. In fact normal milk was never obtained from either rear quarter of the udder.

Production for 365 days during the first lactation period which commenced at 2 years 6 months of age, amounted to 7,223 pounds of milk and 410 pounds of butterfat. The highest month's production amounted to 775 pounds of milk and 42.01 pounds of butterfat. Calving again at 3 years 9 months, and milked three times daily as before, she produced 677.3 pounds of milk and 31.67 pounds of butterfat in the first 20 days before the onset of septicemia resulting from udder infection, which caused her death. Compared with the 509.6 pounds of milk and 21.71 pounds of butterfat produced during the first 20 days of her first lactation, this represents an increase of 32.9 per cent in milk and 45.9 per cent in butterfat. This is a much greater increase than that attributable to age and, although it represents only a limited period of time, it indicates that the first record did not overemphasize the cow's ability to produce.

Figure 1 shows the external appearance of the udder of this cow on

FIG. 1. Cow No. 1074, 9 days after second calving and shortly before the onset of the udder infection that caused her death.

August 1, 1935, nine days after her second calving and only a few days before the onset of the udder infection that caused her death. Figure 2 represents a vertical longitudinal section through the left half of the udder, through the plane of the teats. It is readily discernible that the tissues of the front (usually the smaller) quarter had pushed backward and displaced

a large part of the space normally occupied by the rear quarter. In fact if a vertical transverse cut had been made through the rear quarter it would have passed through tissue more than half of which apparently was contributing to the secretion of the front quarter. Figure 2 shows the surface on the median side of the section, making the rear teat appear at the left side of the picture.

Figure 3 shows the rear surface of a vertical transverse section through the right half of the udder. The surface illustrated represents a plane directly above the center of the rear teat. Although the illustration in Figure 3 is entirely different in appearance from that in Figure 2, owing to the manner of sectioning, it shows that essentially the same change had occurred in both the right and left halves of the udder. In Figure 3, for example, the tissue identified with the rear quarter is confined to a thin, dark-colored layer along the base and a small dark-colored area which appears in the upper left portion of the section. The rest consists of tissue of the front quarter that had crowded toward the rear until it occupied most of the area above the rear teat normally occupied entirely by rear quarter tissue. In this plane, directly above the rear teat, the front quarter appears to occupy about two-thirds of the glandular portion of the section.

The occurrence of production records made when one or more quarters of the udder are non-functioning is a source of no little annoyance to one making a comparative study of the innate producing capacity of dairy cows. This situation is often met in evaluating the transmitting ability of herd sires on the basis of the comparison of the production of the sire's daughters with that of their dams. Sometimes, under such circumstances, attempts have been made to estimate the quantity of milk or butterfat the cow would have produced if all of her quarters had been functioning normally. Some have attempted to compensate for such a handicap by crediting the cow with additional amounts representing certain percentages of the quantity of milk or butterfat she actually produced. Such credits might be based on the assumption that a cow milking from three quarters of the udder would produce only three-fourths as much as she would if all four quarters of the udder were functioning. Even if that theory were sound it would appear that consideration should be given to the question of whether the "blindness" occurred in a front or in a rear quarter as it is fairly well established[2,3] that, on an average, the front quarters produce only slightly more than 40 per cent of the total yield of the udder. But what certainty is there that a "blind" quarter does constitute a serious handicap? Is it not reasonable to believe that if one quarter of the udder fails to function the other quarters may assume greater activity and at least partly compensate for the loss?

[2] Turner, C. W. The functional individuality of the mammary glands of the udder of the dairy cow. Mo. Res. Bull. 211, p. 48. 1934.

[3] Unpublished data of B.D.I.

FIG. 2. Vertical longitudinal section through the left half of the udder of cow No. 1074, in the plane of the teats. Photograph shows median surface of section. Dotted line shows extent to which the front-quarter tissue has invaded the rear-quarter territory.

FIG. 3. Vertical transverse section through the right half of the udder of cow No. 1074 in a plane above the front half of the rear teat. Photograph shows posterior surface of section.

If one were to attempt to adjust the two-year-old, 365-day production record of this cow (No. 1074) to compensate for the loss of both rear quarters, and consideration were given to the normal expectancy of approximately 40 per cent of the total yield of the udder being produced by the two front quarters, the calculated producing capacity of this cow would be 18,057 pounds of milk and 1,025 pounds of butterfat as a 2-year-old. Correcting further for age on the basis of accepted factors would give an estimated mature production capacity of 23,294 pounds of milk and 1,282 pounds of butterfat for this cow. There is no reason to believe she possessed an inheritance for production that even approached such a high level.

In view of the record made by this cow in her first lactation, and the position of the front quarter tissue above the rear teat in an udder that did not suffer severely in fullness in the rear as shown by Figures 1 and 2, there can be little doubt of the ability of Nature to compensate to a large extent for the loss of quarters—particularly when such a loss occurs early in life—though there is no certainty that such compensation always occurs.

AN EVALUATION OF SEVERAL METHODS OF COOLING CREAM[1]

W. J. CAULFIELD AND W. H. MARTIN
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One of the practical difficulties encountered in the section of the central west where a large percentage of the butterfat is marketed as sour cream is to provide adequate refrigeration for the cream prior to churning. The enormous losses from defective butterfat, especially during the hot months of the year, make it imperative that some simple, practical method of cooling cream be devised. Mechanical refrigeration has not been widely used in the production of cream for buttermaking because of the comparatively small volume of cream produced on the average farm. The two most common methods of cooling which have been used in the cream buying stations are the wet sack or evaporation and the spray systems. Although these methods of cooling cream have been used for a number of years, little is known about their actual value and reliability. Fouts and Keith[2] have recommended them for use in Oklahoma, and have given plans and specifications for the construction of a spray cooler. The factors affecting the efficiency of these two systems of cooling have been studied by Martin, Fay and Caulfield,[3] who concluded that neither of these methods of cooling should be regarded as a final and satisfactory method for cooling cream in the station. They recommend their use, however, until some more practical method could be perfected. Numerous other studies have been made of the cream cooling problem; however, they have not dealt with the evaporation or spray method of cooling.

The purpose of this investigation was to determine the relative merits and also the limitations of some of the more commonly used methods of cooling cream including: (1) placing cans of cream in a refrigerator, (2) partially submerging the cans in water, (3) allowing water to flow over the outside of the can, (4) using a spray, and (5) using evaporation. In addition, the effectiveness of the evaporation method of cooling sweet and sour cream through a wide range of atmospheric temperatures and humidities was determined. The feasibility of using the evaporation method to prevent a rise in temperature of cream which had been previously cooled was also studied.

PROCEDURE

The cream used in this study contained 35 per cent butterfat. Forced air circulation was provided in all trials in which the evaporation method

Received for publication September 21, 1937.

[1] Contribution No. 120 from the Department of Dairy Husbandry.

[2] Fouts, E. L., and Keith, J. I. Improving the quality of Oklahoma butter. Okla. Agr. Exp. Sta. Bul. 226. 1935.

[3] Martin, W. H., Caulfield, W. J., and Fay, A. C. The evaporation and spray systems of cooling cream. Kan. Agr. Exp. Cir. 180. 1936.

of cooling was used. In all cooling trials the cream was stirred at thirty minute intervals through the first six hours of each trial. Unless otherwise stated the temperatures of the cream were taken after stirring the contents of the can.

COMPARISON OF FIVE DIFFERENT METHODS OF COOLING CREAM

Five ten-gallon cans of sour cream were adjusted to approximately 90° F. and cooled by five different procedures. The trial was then repeated and two similar trials were made using sweet cream. One can was placed in a refrigerator maintained at 35–40° F.; a second can was placed in a cooling tank through which flowed continuously 126 gallons of water per hour, at 66–68° F. (submerged); a stream of water of the same volume and temperature as was used in the cooling tank was directed into the lid of a third can and allowed to flow over the outside of the can (flooded); a fourth can was placed under a coarse spray which delivered 220 gallons of water 67–68° F. per hour, and the remaining can was covered with a wet sack, placed in a room with a temperature 92–98° F. and cooled by evaporation. The rate of temperature change which occurred in each of the five cans during the cooling period was recorded at thirty minute intervals.

Under the conditions of this trial the rate of cooling during the first two hours was fastest by the submerged method, this being followed in order by the flooded, refrigerator, spray and evaporation methods (Fig. 1). At the end of six hours the cream placed in the refrigerator was cooled to a slightly lower temperature (2–4° F.) than that cooled by either the submerged or flooded methods of cooling, and to from 5–12° F. lower than the cream cooled by either the spray or evaporation methods. The use of a spray proved somewhat more efficient than the exaporation method in this comparison.

Sour cream, irrespective of the method of cooling, did not cool so rapidly nor to quite so low a temperature as did the sweet cream (Fig. 1). The greatest difference in the final temperature of the cooled sweet and sour cream, however, amounted to only 6° F. This temperature difference occurred when the flooded method of cooling was used. These results would indicate that with frequent stirring sour cream may be cooled at approximately the same rate and to about the same temperature as sweet cream in a given period of time.

EFFECT OF ROOM TEMPERATURE AND HUMIDITY ON THE EVAPORATION METHOD

In a previous study[3] it was determined that room temperature and humidity had a marked influence on the efficiency of the evaporation method. The purpose of this phase of the present study was to determine what results might be obtained when the evaporation method was used for cooling cream under various combinations of room temperatures and humidity.

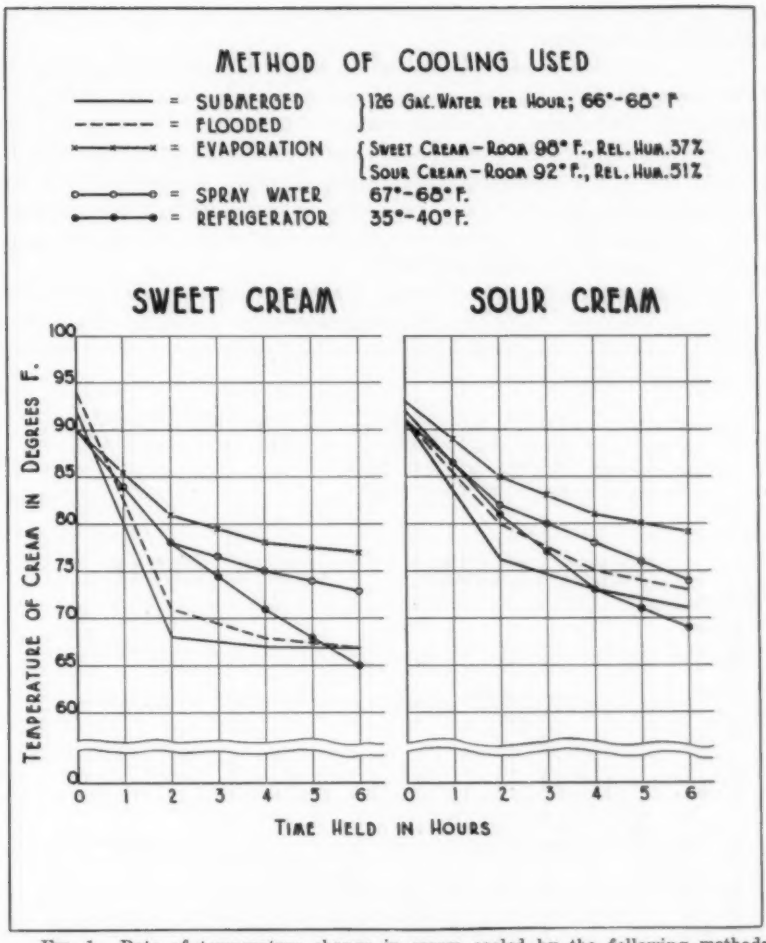

FIG. 1. Rate of temperature change in cream cooled by the following methods: flooded, submerged, evaporation, spray, and refrigerator.

In each of 10 trials (5 with sweet, and 5 with sour cream) a ten-gallon can of cream adjusted to approximately 90° F. was cooled by the evaporation method for 48 hours. The room temperatures and humidities were not artificially regulated in any of the trials. The room temperatures in the various trials ranged from 63–104° F. while the humidities varied from 25 to 68 per cent. A thermograph and hygrograph of the recording types were used to follow continuously the room temperature and humidity. The temperature of the cream was determined by means of a recording thermometer, the bulb of which was inserted and sealed into an opening in the side of the

can. A second thermometer of known accuracy was used as a check on the recording thermometer.

About six hours were required for the cream to reach the lowest attainable temperature at any given room temperature and humidity combination (Table 1). Variations in the temperature of the cream following the first six to eight hours of each trial were the result of changes in the temperature or humidity of the room or a combination of these. It was observed that fluctuations in room temperature tend to be accompanied by similar changes in the temperature of the cream but with some lag in time, which is in agreement with results previously reported.[3]

The temperature to which cream may be cooled by the evaporation method is definitely limited by the temperature and humidity of the room

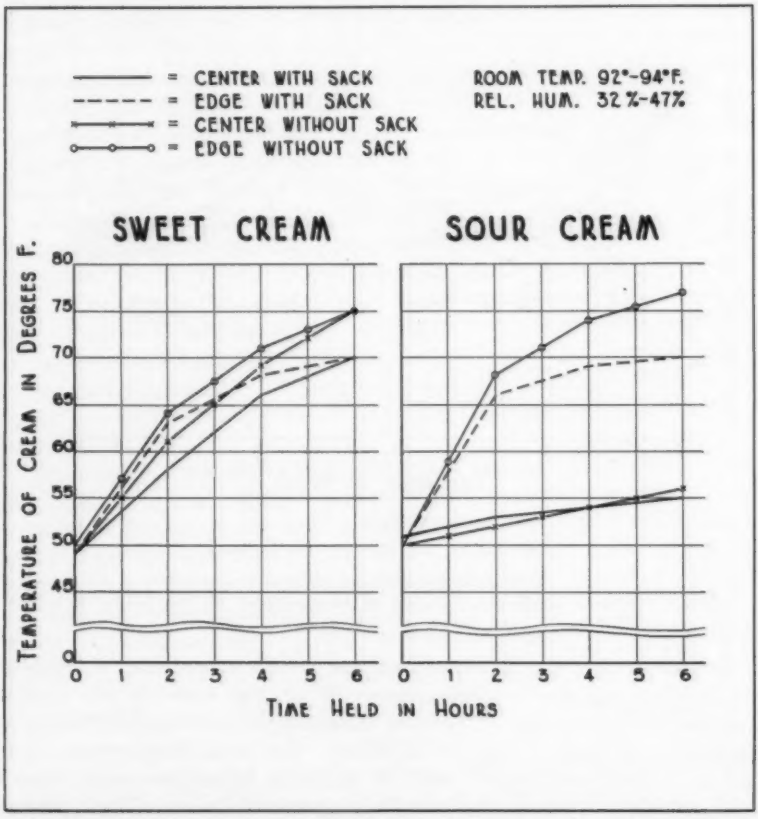

FIG. 2. Rate of temperature rise in cooled cream (35 per cent fat), with and without sacks. (Average of 3 trials with sour and 2 with sweet cream.) Room temperature 92–94° F. (Relative humidity 32–47 per cent.)

TABLE 1

Relation of relative humidity and room temperature to the temperature of sweet and sour cream cooled by evaporation

TRIAL NO.	CONDITION OF CREAM	RELATIVE HUMIDITY OF ROOM (PER CENT)		ROOM TEMPERATURE IN DEGREES F.		CREAM TEMPERATURE IN DEGREES F.		DIFFERENCE BETWEEN ROOM AND CREAM TEMPERATURES	
		Ave.	Range	Ave.	Range	Ave.	Range	Ave.	Range
1	Sweet	52	39–57	103.0		86.0	82–88	17.0	15–21
2	Sour	43	39–39	103.5	103–104	83.0	82–84	20.5	19–22
3	Sweet	47	32–70	92.0	76–100	77.0	71–78	15.0	0–22
4	Sour	34	25–43	89.0	79–92	73.0	72–76	16.0	11–16
5	Sweet	46	32–60	88.0	86–94	72.0	70–74	16.0	13–20
6	Sour	63	54–68	85.0	83–87	76.0	75–78	9.0	7–10
7	Sour	52	46–59	85.0	82–89	72.0	69–73	13.0	11–16
8	Sweet	49	41–55	80.0	78–82	70.0	68–71	10.0	8–14
9	Sour	48	45–49	72.0	66–74	62.0	57–64	10.0	9–12
10	Sweet	44	41–49	71.0	68–73	56.0	55–58	15.0	13–16

(Table 1). A reduction in the temperature of the room, provided the humidity did not exceed 60 per cent, was accompanied by a reduction in the temperature to which the cream was cooled and held. When the room temperature averaged 103.5° F. for example the temperature of the cooled sour cream ranged from 82–84° F. When the room temperature averaged 89° F., however, the cream was cooled and held at 72–76° F., and when the room temperature was approximately 72° F. the temperature of the cream ranged between 57–64° F. (Table 1). Similar relationships between the room temperature and the temperature to which cream may be cooled were observed in trials with sweet cream (Table 1).

The influence of humidity on the efficiency of the evaporation method may be observed by a comparison of trials 6 and 7 (Table 1). The room temperature in both of these trials was quite uniform averaging 85° F. The humidity, however, averaged uniformly higher in trial 6 than it did in trial 7. Likewise the temperature of the cream averaged from 3 to 5° F. higher in trial 6 than it did in trial 7. Relative humidities in excess of 60 per cent appear to definitely impair the efficiency of the evaporation system of cooling.

EFFECTIVENESS OF THE EVAPORATION METHOD FOR HOLDING CREAM

The data obtained in the preceding trials indicate that cream cannot be cooled adequately in extremely hot weather by the evaporation method. The question arose as to how effective this system of cooling would be in preventing an undue rise in temperature in cream which has been previously cooled.

In each of five trials (3 with sour, and 2 with sweet cream) two ten-gallon cans of cream were cooled to approximately 50° F. and exposed in a room at 92–94° F. One can in each pair was protected with a sack, whereas the other can was unprotected. Since the object of this experiment was to prevent temperature changes in the cream it was not stirred until the end of the trial. Temperatures were taken at the center and edge of the cans.

The data show that the use of sacks on cans of cooled cream retarded the rate of temperature change in the cream (Fig. 2). The temperature of the sweet cream in the unprotected can averaged 76.5° F. at the end of seven hours exposure as compared with 70° F. for that protected by means of a wet sack. In the case of the sour cream the temperature was 75° F. in the unprotected can as compared with 70° F. in the protected can. Thus there was an average temperature difference of 6.5° F. in the cans of sweet cream and 5.0° F. in the cans of sour cream at the end of the trial in favor of the cans protected by sacks.

Had the trial been conducted over a longer period the effectiveness of the evaporation method in keeping cream cold might have been demonstrated more clearly. In the preceding trials (Table 1) it was shown that with a room temperature of over 90° F. one may reasonably expect the

evaporation method to maintain the cream about 15° F. below this temperature or at approximately 75° F. Hence the temperature of the cream in this study had not reached the point where the evaporation method would become effective at the end of the trial. It seems evident, however, that temperatures which can be maintained by the evaporation method when used for holding cream will be determined largely by the temperature and relative humidity of the room.

A comparison of the data for sweet and sour cream shows that sour cream does not warm up so rapidly nor to the same extent as sweet cream when held under similar conditions (Fig. 2). The results indicate that sour cream if delivered properly cooled may be held for longer periods under adverse temperature conditions than can sweet cream without an undue change in temperature.

DISCUSSION

Of the various methods of cooling compared in this study the use of a refrigerator box maintained at 35–40° F. would approach the ideal condition for the storage of cream. The practical difficulty of providing such facilities in the average cream station, however, would definitely limit the use of this method to a very few of the larger stations and creameries receiving their cream direct.

If an ample supply of cold water is available the use of a cooling tank through which cold water flowed continuously would be a more practical, efficient, and convenient system of cooling than either the spray or flooded systems. When the spray method is used, cooling is accomplished primarily by the conduction of heat away from the can by cold water and very little if any is due to the evaporation of the water. Furthermore, it has been reported[3] that considerable heat is absorbed from the surrounding atmosphere by the spray water when this method is used, thereby raising the temperature of the water which is used for cooling. There is no appreciable absorption of heat from the surrounding atmosphere by the cooling water when allowed to flow continuously through a cooling tank in which the cans of cream are placed. Although the flooded system as used in this study proved to be practically as efficient as the use of a cooling tank, the latter method would be more practical and convenient to use. The feasibility and practicability of using any method of water cooling would be dependent upon the availability of running water at reasonably low temperature.

Although the evaporation method cannot be relied upon to cool cream adequately in exceeding hot weather, the use of this method would certainly be better than no cooling at all. The method is best adapted for room temperatures not in excess of 85° F. and humidities not in excess of 50 per cent. Under such conditions it should be possible to cool and maintain cream at approximately 70° F. or below. Cream maintained at 70° F. will remain in the first grade much longer than that which is held at 85° F. or above.

SUMMARY AND CONCLUSIONS

A study has been made to compare the relative efficiency of five different methods of cooling cream including: (1) placing cans of cream in a refrigerator, (2) partially submerging the cans in a cooling tank containing continuously flowing water (submerged), (3) allowing water to flow over the outside of the can (flooded), (4) use of spray, and (5) use of the evaporation method. In addition the effectiveness of the evaporation method of cooling sweet and sour cream through a wide range of atmospheric temperatures and humidities was determined. The feasibility of using the evaporation method of cooling in preventing a rise in the temperature of cream which had been previously cooled was also studied.

The results obtained in this study may be summarized as follows:

1. The rate of cooling during the first two hours of the trial was fastest by the submerged method, followed in order by the flooded, refrigerator, spray, and evaporation methods of cooling. At the end of the six-hour trial the cream placed in the refrigerator was cooled to a slightly lower temperature than that cooled by either the flooded or submerged methods of cooling and to from 5–12° lower than the cream cooled by either the spray or evaporation method. The spray system was slightly more efficient than the evaporation method under the conditions of this trial (room temperature 92–98° F.).

2. Sour cream, irrespective of the cooling method used, did not cool so rapidly nor to quite so low a temperature as did sweet cream.

3. It required about six hours for either sweet or sour cream to reach the lowest attainable temperature under a given set of conditions, when cooled by the evaporation method.

4. The temperature to which cream may be cooled by the evaporation method was definitely limited by the temperature and humidity of the room. When the room temperature averaged 103.5° F. sour cream was cooled to 82–84° F. When the room temperature averaged 89° F., however, the cream was cooled to 72–76° F., and when the room temperature was approximately 72° F. the temperature of the cream was reduced to 57–64° F.

5. If the relative humidity is held rather constant, fluctuations in the room temperature tend to be accompanied by corresponding changes in temperature of the cream, but with some lag in time when the evaporation process is used for cooling.

6. Efficiency of the evaporation system of cooling was impaired when the relative humidity exceeded 60 per cent.

7. The evaporation method retarded the rate of temperature rise in cooled cream and prevented the temperature of the cream from going above that attainable by this system of cooling. The temperature rise was less rapid in sour than in sweet cream indicating that viscous sour cream was a poorer conductor of heat than sweet cream.

A RAPID PHOSPHOMONOESTERASE TEST FOR CONTROL OF DAIRY PASTEURIZATION

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Although health authorities seek to carefully define the requirements of pasteurization by means of ordinances, they are repeatedly confronted by failures to comply with regulations. The human element involved in the pasteurizing process and many of the mechanical factors contributing to improper pasteurization cannot be satisfactorily controlled by routine physical inspection of plants. Temperature recording devices may become inaccurate or inoperative between the visits of plant inspectors. Some defects are apparent only to an inspector who has studied the many and complex types of pasteurizing systems and individual equipment utilized. Other irregularities cannot be detected visually.

The holding process of pasteurization (which is the most widely used in this country) as required by the New York City Sanitary Code consists of heating the milk to at least 143° F. and holding it at that temperature for at least 30 minutes, after which it is rapidly cooled. In many cases, however, there is not always assurance that all the milk is held for the desired time or that the proper temperature has been employed. Properly pasteurized milk may be contaminated with under-heated foam (1). Without agitation in the holding tank, there is always the risk of non-uniform temperature distribution. In this connection we note the New York State definition (Sanitary Code Regulation 22): "No milk or cream shall be labeled or designated as pasteurized unless every particle of such milk or cream has been subjected to a temperature of 143° F. or more, continuously for not less than 30 minutes. . . ." The Federal definition also emphasizes *every particle.*

Chemical tests thus far proposed for the detection of improperly or inefficiently pasteurized milk may be grouped for simplicity based on:

1. Microscopic examination: Cellular test of Frost (2).

2. Physical properties: Creaming test (3), Turbidity (4), Cheesing (5), Lactalbumin (6), Suspensions (7).

3. Enzyme activity: Peroxidase (8), Catalase (9), (10), Aldehydereductase (11), Amylase (8), (12), (13), and Phosphatase (14).

With the advent of low temperature pasteurization many of these tests have been inapplicable or are not satisfactory (6, 8, 12, 15, 16, 17, 18, 19, 21, 22, 23). There seems to be a personal factor or equation in almost all the methods thus far reported which exposes them to the criticism of failure at duplication by other workers. Early in 1935, this writer developed a

Received for publication October 4, 1937.

modified amylase test which in some thousands of applications always distinguished raw milk as such and indicated the presence of 5 per cent of added raw milk, or an over-all heating period of fifteen minutes or less, or when a temperature of 140° F. or less had been employed. Results obtained from the use of this modified method were encouraging, and indicated that a more sensitive method was needed.

The recently proposed phosphatase test (14) offers greater sensitivity but is somewhat lengthy and involved for routine analysis. Although Kay and Graham suggested that for American temperatures of pasteurization ($142.5 \pm 2.5°$ F.) $2\frac{1}{2}$ hours of incubation were sufficient, Gilcreas and Davis (20) found that 24 hours were required for fine distinctions on the quantitative test. Results in this laboratory are in agreement on that point. Critical preparation of the Folin and Ciocalteu reagent was essential and somewhat expensive. Furthermore, this reagent is lacking in specificity, reacting with many substituted phenols and even with tin and ferrous iron (24, 25).

In January, 1937, the application of various protein precipitants in conjunction with other phenol reagents was investigated and in this connection it was found that basic lead acetate when used with 2,6 dibromoquinonechloroimide was entirely satisfactory. The sensitivity of this reagent (hereinafter termed "BQC") to phenol is one part in twenty million. It reacts with only those phenols in which the position part to the hydroxyl group is unsubstituted to form indophenols giving rise to blue colorations upon which a quantitative estimation of phenols may be based (26). A technique devised to fit the requirements of this reagent is herewith presented which is short, inexpensive, uses only such equipment as can be found in the average health department or dairy laboratory, and is reasonably devoid of personal equation. Although only a limited number of determinations (about 10,000) were made, excellent checks were obtained and the method seems worthy of further detailed study.

Application is made of the destruction of phosphomonoesterase,[1] a constant constituent of raw milk, by heat treatment, 96 per cent being destroyed at 143° F. in 30 minutes (14) and the ability of this enzyme to hydrolyze disodium phenylphosphate (27) with the liberation of phenol which is estimated colorimetrically with 2,6 dibromoquinonechloroimide. The test is conducted in an alkaline medium about pH 9.6 which is optimum for the development of coloration. At a lower pH, development is unduly prolonged while at a higher pH color may fail to develop (26). The greater the amount of phenol present, the more rapid the development of color; excess of the

[1] Folley and Kay (28, 29, 32) classify the phosphatases, terming as alkaline phosphomonoesterase the phosphatase in milk which is active at an alkaline pH. It seemed wise at this point to particularize on this name in order to differentiate the qualities of this enzyme from other phosphatases.

imide also speeds formation of the indophenol but too great an excess with small amounts of phenol add yellow to the blue.

THE MODIFIED PHOSPHATASE METHOD

Reagents

2,6 Dibromoquinonechloroimide (Referred *infra* as BQC) (Eastman Kodak Chemical No. 2304)

Dissolve 0.04 gram in 10 ml. of 95 per cent ethyl alcohol. When tightly stoppered this solution is stable for several days. It was found convenient to keep this solution in an Owens ¼-ounce green glass pharmaceutical dropper bottle (Design No. 90943). This size dropper bottle delivers 50 drops to the cubic centimeter of the alcoholic solution of the imide. Two drops or 1/25 ml. of the imide contain 0.16 milligram. This has been indicated as an adequate excess.

Basic Lead Acetate (prepared by the Horne Method) A.C.S. specifications

Boil 280 grams of the dry basic lead acetate with 500 ml. of water for 5–10 minutes. Cool, allow to settle, filter and dilute to 500 ml.

Borate Buffer Solution

Dissolve 28.427 grams of $Na_2B_4O_7 \cdot 10\,H_2O$ (analytical grade) in 900 cc. of warm distilled water. Stir vigorously while powder is being added to prevent lumping. Add 3.27 grams of NaOH in the form of a strong solution (2 to 5 Normal), cool and make up to a liter.

Buffered Substrate

The Disodium phenyl phosphate obtained from British Drug Houses Ltd., was found to contain considerable free phenol.[2] Accordingly the salt was washed with ethyl ether until the washings gave a negative test for phenol. In making this test, add 10 ml. of distilled water to 100 ml. of the ether washings, evaporate off the ether, add ½ ml. of the borate buffer, then add 4 drops of BQC. The development of a blue color indicates the presence of phenol.

The washed salt should be air dried briefly to remove the ether, then dried in a desiccator. Store in a refrigerator.

Dissolve 1.09 grams of the washed and dried salt in 900 ml. of distilled water previously saturated with $CHCl_3$. Add 50 ml. of borate buffer solution. Make up to 1 liter. Add a few drops of $CHCl_3$. Store in refrigerator. The pH of this buffer substrate is about 9.6 and should be checked using Thymolphthalein as an indicator.

Phenol Color Standards

Prepare a solution of phenol in distilled water standardized at 0.1 mg. per ml. (30). Dilute the required number of milliliters to 100 ml. to give solutions containing ½, 1, 1½, 2, 3, 4, 5, 10, 20, 50 and 100 parts per million. To make color standards, take 5 ml. portions of these solutions, add ¼ ml.

[2] This salt suitably phenol free may be obtained from Eimer & Amend, New York, or R. P. Cargille, New York.

borate buffer and two drops of BQC solution. Stopper tightly. These color standards are stable for several weeks if stored under refrigeration and kept out of direct sunlight when used.

It is proposed for convenience to identify as the unit of blue, the amount of color produced by 0.001 mg. of phenol per 5 ml. of solution. Thus the standard containing ½ p.p.m. phenol would contain 0.0025 mg. (2.5 gamma) of phenol per 5 ml. or 2.5 units, the standard containing 1 p.p.m. would contain 0.005 (5 gamma) per 5 ml. or 5 units, etc.

Method

A blank should be run on the reagents daily. If the blank produces any blue color, the solution of buffer substrate should be discarded.

By means of a pipette (a different pipette for each sample) transfer 1 ml. of the milk to be tested to a pyrex test-tube. (The pipette should be plugged with cotton to prevent contamination with saliva. It was found convenient for rapid work to use a pipette not graduated to the tip so that no drainage was required.) Add 10 ml. of the buffer substrate. Shake well. Incubate for one hour at 37.5° C. After incubation, place tubes in boiling water for 5 minutes. Cool in ice water. Add 0.1 ml. of Basic Lead Acetate solution. Shake well. Allow to stand for a minute or two. The proteins will coagulate and separate sharply (in some instances it may be necessary to add an additional 0.05 ml. of the lead acetate to completely precipitate the protein). Filter. To 5 ml. of the clear filtrate add 0.25 ml. of the borate buffer. Add 2 drops or 0.04 ml. of BQC. Shake gently.

The blue color of the indophenol reaction develops within five minutes; the greater the amount of phenol present the more rapid the development. Allowing fifteen minutes for development, the color adduced is then compared with the phenol color standards and reported as phosphomonoesterase units—a unit being the amount of enzyme which under conditions of the test would produce the color equivalent of 1 gamma of phenol.

Precautions To Be Observed in Making the Laboratory Test

(A) Samples of milk and cream, especially if stored under refrigeration, should be warmed to room temperature before pipetting.

(B) If an incubator rather than a water bath is utilized, it is suggested that the test-tubes, before being placed in the incubator, be placed for a minute or two in water at a temperature of about 40° C.

(C) Occasionally following the use of the basic lead acetate, the filtrate is not water clear, or the filtrate becomes clouded as a result of the addition of ¼ cc. of the borate buffer. Centrifuging at a speed of about 800 r.p.m. will serve to clarify the serum. The precipitate does not seemingly interfere with the indophenol development.

(D) Whatman No. 40 filter paper was utilized in the investigation but for routine work any good quality of filter paper will serve.

(E) Suitable precautions must be taken to prevent the action of human salivary phosphatase.

EXPERIMENTAL DATA

Effect of Variation in Pasteurization Time and Temperature

Samples of mixed herd raw milks were heated in the laboratory under various times of holding at 143° F. and examined. A brief study was also made of the effect of variation in holding time in commercial plants. Samples were taken by inspectors under as nearly identical conditions as possible from four different pasteurizing plants representing two small size batch pasteurizers and two multiple unit automatic holders.

TABLE 1

Effect of time held at 145° F. expressed in proposed phosphomonoesterase units

	LABORATORY HEATED SAMPLES (PREHEATING 1 MINUTE)		
	Minimum	Maximum	Weighted average
Raw milk	500 Units	> 500	> 500
5 minutes heating	100	250	100
10 " "	20	50	35
15 " "	15	20	17.5
20 " "	10	10	10
25 " "	5	5	5
30 " "	0	< 2.5	< 2.5

	SAMPLES FROM COMMERCIAL PASTEURIZING PLANTS			
	Plant A	B	C	D
Raw milk	> 500 Units	> 500	> 500	> 500
5 minutes heating	40	50	100	50–100
10 " "	20	20–25	40	50
20 " "	10	10	15	25
25 " "	2.5–5	2.5–5	5–10	5–10
30 " "	2.5	< 2.5	< 2.5	< 2.5
Routine bottled milk	2.5	< 2.5	< 2.5	< 2.5

Plant A. Milk preheated in I-T heater approximately 60 seconds. Held in multiple automatic precision holder.

Plant B. Milk preheated in I-T heater approximately 60 seconds. Six and a half minutes required to fill holding tank. Six Cherry Burrell Spray holders. Three minutes required to empty holding tank. Milk cooled to 50° F. after holding period, in 30 seconds.

Plant C. Small batch pasteurizer. Milk required preheating period of 15 minutes before temperature of 143° F. was reached. Cooled after pasteurization by surface cooler.

Plant D. Small batch pasteurizer with continuous agitator. Preheating time in vat was 15 minutes. Cooled in vat five minutes.

It should be noted in connection with the above commercial plant samples (Table 1) that time indicated may not have been exact. Some samples received an additive holding time of 143° F. necessitated by the time required to fill the holding tanks, following which the holding period starts. Raw milks from each of 34 cows gave a value of 500 or more phosphomonoesterase units. In no instance did properly pasteurized milk (laboratory or commercial plant) yield a color indicative of more than 2.5 phosphomonoesterase units. Experience has shown that this value is somewhat generous in that

properly pasteurized samples uniformly show less than this amount of enzyme activity. There is no question of the ability of the test to discriminate between raw and pasteurized milk. Variations of five minutes or more in the holding time can be readily distinguished. Milk heated for 25 minutes can be distinguished from pasteurized milk. The reaction of milk heated for 5 minutes can be distinguished from raw milk. The results in Table 1 apparently show that the enzyme in question is more effectively destroyed in an automatic precision holder than in the older type batch pasteurizer and that quick preheating of the milk was more effective in destroying the enzyme than slow preheating. These indications however are based on a very limited number of determinations.

Samples of mixed herd milk were heated for 30 minutes in the laboratory at various temperatures (Table 2). The results are summarized.

TABLE 2

Effect of variation in temperature of heating for 30 minutes, expressed in proposed phosphomonoesterase units

TEMPERATURE	AVERAGE VALUE
° F.	
138	250–50 units
140.5	100 "
142	10 "
143	2.5 "

The effect of the addition of varying proportions of raw milk to properly pasteurized milk is expressed in Table 3. It will be noted that the addition of 0.5 per cent of raw milk to properly pasteurized milk could be readily determined.

Experience in the past six months of both laboratory prepared and commercially heated milk has shown that whenever the value obtained as a result of this method exceeded 2.5 units, said milk was underpasteurized or improperly pasteurized and that the greater the number of units obtained, the more improper the conditions under which such milk was processed. It is not possible however, as a result of routine examination, to correctly designate whether this condition be due to either a variation in holding time, or a drop in temperature, or the addition (through leakage or improper design of equipment) of raw or improperly pasteurized milk, or contamination with underheated foam, or any combination of the foregoing. Experience further demonstrates that it is not necessary to run a control for each sample. If this be desirable in order to eliminate the possibility of phenol or phenolic products which would react with BQC being present in the milk sample originally, it can readily be performed by the substitution of a water solution (buffered to a pH of 9.6) for the buffer substrate solution and continuing either with the method as outlined previously or the quick "field" test as outlined subsequently in this article. It might be of further interest to state that even where commercially so called "pasteurized" milks developed 500

units as a result of incubation with the substrate, the control gave a negative result for phenol.

EFFECT OF STORAGE CONDITIONS

It has been indicated (14, 20) that when milk has soured or putrefied during storage, an increase in the color value might be obtained in the Kay and Graham test due to the action of certain bacteria or to protein decomposition which might liberate phenol or phenol-like products. Such a condition might classify a properly pasteurized milk as an underpasteurized product. Some of these decomposition products such as Tyrosine and Tryptophane will give blue color with the Folin and Ciocalteu reagent (25). A view at the structural formulae of these and related compounds indicates that the position para to the OH group has already been substituted or that the compound does not contain an OH group, in either case theory suggests that there would be no reaction with BQC to form the indophenol.

Forty-two samples obtained from several commercial plants (under various holding times at 143° F.) and 22 laboratory-prepared samples (representing variations in holding time, in temperature and mixtures of raw and pasteurized milk) were allowed to age under storage conditions of refrigeration, and tested from time to time. Tables 3, 4, 5 and 6 indicate the results of this study.

Improperly pasteurized milks were indicated after a considerable lapse of time. The apparent decrease in phosphomonoesterase units may have

TABLE 3

Results under storage conditions of the addition of raw milk to pasteurized milk

PERCENTAGE OF RAW MILK ADDED	UNITS OF PHOSPHOMONOESTERASE		
	1 day	7 days	14 days
0.0	< 2.5	< 2.5	< 2.5
0.2	< 5	< 5	< 5
0.5	5	5	5
1.0	10	>10	<10
2.0	15–20	>10	>10
5.0	20–50		
10.0	100		

TABLE 4

Effect of storage conditions of commercial pasteurized milk on the test

INSPECTORS DESIGNATION	ELAPSED TIME IN DAYS							TITERED TO pH 6.6 WITH Na_2CO_3 BEFORE SAMPLING (50 DAYS)
	1 day	6 days	10 days	20 days	27 days	35 days	50 days	
Raw	500	500	500	>100	15	15	15	500
5 minutes	100	100	20	10	15	5–10		
10	25	20	10	5	10	5–10		
15	10	10	5	2.5	5	5–10	2.5	5
20	5	5	>2.5	>2.5	<5	<5		
25	2.5	2.5	<2.5	<2.5	<2.5	<2.5		
30	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5

TABLE 5

Effect of storage conditions on samples heated less than 143° F. for 30 minutes, expressed in proposed units

TEMPERATURE	AGE IN DAYS					TITERED WITH Na_2CO_3 BEFORE SAMPLING AFTER 27 DAYS
	1	3	6	10	27	
°F.						
138	500	500	100	100	10	50–100
140.5	100	50–100	50	15	5–10	20
142	10	5–10	10	5	2.5	2.5–5
143	2.5	2.5	2.5	2.5	2.5	2.5

TABLE 6

Results of souring under storage conditions, expressed in proposed units

	SAMPLE NUMBER	AGE IN DAYS				
		1 day	7 days	10 days	20 days	50 days
Raw milk	1	500	500		500	500
	2	500			500	500
	3	500		500		500
	4	500	500	500	100+	
Preheated	5 A	500				500
	6 B	500			500	100
	7 C	500				500
	8 D	500				
	9 A	15	15	15		5
Held 10 minutes at 143° F.	10 A	40	40	40		20
	11 A	25	20	10	5	5
	12 C	50	50	50		
	13 D	20	20	20		10
	14 A	20	25	20	15	
	15 A	25	25	20		
Held 20 minutes at 143° F.	16 B	5				2.5
	17 B	10	10	<10		<5
	18 B	5	5	2.5	2.5	
	19 C	25	20			2.5
	20 D	10	10	5		2.5
	21 A	10	10	10	5	
	22 A	10	10	10	5	

A = Laboratory preheating 1 minute.
B = Commercial plant " 1½ "
C = " " " 15 minutes.
D = " " " 15 " accompanied by agitation in tank.

been due to the increase in acidity coupled with the inadequacy of the buffer under such extreme conditions to maintain the optimum pH for activity of the enzyme. Moreover due to the condition of the milks, it was difficult to obtain a representative sample. A portion of some of the milks were titered with Na_2CO_3 to an approximate pH of 6.6 before sampling and proceeding with the analysis. The results obtained in this fashion are of considerable interest.

APPLICATION OF THE TEST TO MILK PRODUCTS

Samples of raw cream and samples of commercially pasteurized cream from reliable plants were subjected to the test. No change in technique was

found necessary. Raw creams gave a value in excess of 500 units while pasteurized cream gave a value of 2.5 units (in two instances 5 units).

Chocolate milk could also be analyzed with no change in technique. Experiments now being conducted indicate that butter and other milk products may be examined with little change in the method but because of the very limited number of samples analyzed no data is presented.

SHORT-TIME, HIGH TEMPERATURE PASTEURIZATION

Samples of milk obtained from a York high temperature pasteurizer reacted to the test in the same fashion as normally pasteurized milk. This equipment was rated to heat the milk at 160° F. for 15 seconds. The length of holding when checked with water was found to be 17 to 18 seconds.

APPLICATION OF THE PROPOSED TEST TO COMMERCIALLY PASTEURIZED MILKS AND CREAMS

While it would not be feasible to tabulate the findings on the many samples analyzed, Table 7 indicates some representative results obtained on market samples of milk and cream labeled pasteurized. It will be noted that two classes of samples are considered: routine samples and official samples. The routine samples were submitted primarily for milk fat and total solids determinations, but were also subjected to the pasteurization test. When the result obtained on such sample indicated the possibility of improper pasteurization, an official sample was obtained that same day and submitted solely for analysis by this test. In many instances, inspectors equipped with the "field" test would visit the plant concerned during operation that night, and check operating conditions. Existing improprieties in technique or shortcomings of apparatus were uncovered and demonstrated to the plant operators.

TABLE 7

Selected results obtained on market milk and cream samples designated as pasteurized

NATURE OF SAMPLE	PROPOSED UNITS	REMARKS
Routine cream	100	Improperly pasteurized
Official milk	20	Pumps not regulated, by-pass permitted, holding time improper
Official cream	500	Plant records indicated pasteurization of 20 per cent cent. more than capacity
Official milk	15	Holding period of 20 minutes
Official milk	15	Thermometer 2° off
Official cream	10	Cream standardized after pasteurization with raw or improperly pasteurized milk
Official cream	25	
Official milk	7.5	Excessive foam in vat
Routine cream	7.5	Agitators not operated during holding period
Routine milk	15	Temperature less than 142° F.

The point has been made (33) that slow cooling of milk held at the pasteurizing temperature range for 20 to 40 minutes resulted in reactivation

of some of the phosphomonoesterase, and that with rapid cooling the phosphatase destruction is much greater. This has not as yet been confirmed by the author's experiments but should present no problem since proper pasteurization requires the quick cooling of the milk.

Folley and Kay have shown (31) that the phosphomonoesterase content of cow's milk varies during lactation, rising to a maximum 180 days post partum. There may also be a variation in the enzyme content of the milk of individual cows but this is hardly material when dealing with market milk which is usually mixed or herd milk. They further indicated (29) that the amount of the enzyme present in raw milk bears a relation to the solids not fat.

At present a study is being made to see whether a longer incubation period will increase the sensitivity of this test or aid its diagnostic value. However, since the speed with which hydrolysis occurs decreases with an increase in reaction time and since the activity of a phosphatase solution is not proportional to its concentration, it would seem better to use a short incubation period in which enzymic activity is nearer to true initial velocity of hydrolysis. The catalytic effect of magnesium ions (32) on the sensitivity is also being investigated.

A SHORT FIELD TEST

Because of its simplicity, the procedure previously suggested as a laboratory method, could be used in the field. However it developed that the blue color of the indophenol reaction would appear even in the presence of the milk proteins and fat. The following method was evolved as a field test utilizing the compact fabricoid kit (obtained from R. P. Cargille) shown in Figure 1.

FIG. 1. The compact field kit. Test-tubes are flat bottom, each calibrated at 5 ml. and 5.5 ml. Buffered substrate is added up to lower mark on tube, sample is then added by means of dropper to higher calibration.

To 5 ml. of buffered substrate add 0.5 ml. of sample to be tested. Stopper, shake well. Incubate for 5 to 10 minutes in water at about 100° F. or by placing tube in vest pocket. Following incubation add 6 drops of BQC.

Stopper and shake. Note color after 5 minutes. The appearance of any blue is indicative of improper pasteurization.

Tablets suitable for the preparation of the two necessary solutions are available.

APPLICATION OF THE FIELD TEST

TABLE 8

SAMPLE	INTENSITY OF BLUE COLOR
Raw milk	+ + + +
Milk preheated at 120° F.	+ + + +
" " " 143° F.	+ + +
Milk held 10 minutes at 143° F.	+ +
" " 15 " " " "	+
" " 20 " " " "	±
" " 30 " " " "	−
5% raw milk + pasteurized milk	+ +
2% " " + " "	+
1% " " + " "	±
Raw cream	+ + + + +
Pasteurized cream	−

The indophenol blue develops within 5 minutes and becomes progressively more intense. Properly pasteurized cream yields a grey to white color, while properly pasteurized milk gives a grey to brown appearance. It has been demonstrated that whenever the laboratory test would indicate 10 units or more, the field test would also indicate blue. In some cases the field test reacted as positive on cream when the laboratory test showed only 7.5 units of color. It has even demonstrated the contamination of a pasteurized product with underheated foam. Where the results obtained on this field test are questionable, a sample should be subjected to the more sensitive laboratory test.

The following instance will serve to demonstrate the practical application of the two tests: Cream from plant X in the city was reported to yield a high unit value on the laboratory test. This plant merely bottled bulk "pasteurized" cream which it received from about 20 different country plants. Inspectors using the field test isolated the source responsible. This lot gave a very high phosphomonoesterase reaction, and led to the testing and embargo of a subsequent delivery of a large shipment of cream. It was then shown by the laboratory test that this large quantity of bulk cream was not uniform in its reaction, falling roughly into three classes: 500 units, 100 units and 20 units. An inspector of the Country Milk Division using the field test checked the plant concerned, found certain temperature irregularities in one tank (chart indicated 143° F. but due to inadvertent slipping of the bulb of the recording thermometer so that it rested on the metal bottom of the pasteurizing vat, the actual temperature was only 139° F.); this fact plus lack of agitation and the further observation that this "pasteurized" cream was standardized when necessary by the addition of milk which in turn

was improperly pasteurized, may have accounted for the variation in the amounts of phosphomonoesterase units found. The operative irregularities were corrected and the cream now uniformly indicates less than 2.5 units.

CORRELATION BETWEEN BACTERIA COUNTS AND PHOSPHOMONOESTERASE UNITS

Several thousand commercially pasteurized milks and creams upon which bacteria counts were made were analyzed for phosphomonoesterase activity.

The data are not presented as it is evident that factors other than the thoroughness of pasteurization greatly affect bacterial counts. There were a number of samples giving high bacteria counts with a phosphomonesterase value of 2.5 units. This may have been due to high initial bacterial content of the raw milk, to resistant bacteria, to improper storage, or to the age or the subsequent contamination of the products. However, a low count milk is not always a safe milk.

The phosphomonesterase value of a sample gives no indication of bacterial contamination of a product subsequent to pasteurization.

DISCUSSION OF PRACTICAL VALUE OF THE TEST

During the first month of application of this test, reporting as abnormal (*i.e.*, reacting positive) only those milks or creams whose phosphomonesterase value exceeded 5 units, and applying the rough field test to the sources or plants thus indicated, 23,977 pounds of milk and cream were condemned as improperly pasteurized and excluded from the New York City market.

It is evident as a result of the work done thus far that faulty pasteurization falls into two classes: unintentional and deliberate. The unintentional class may be due to:

(a) Poor or inadequate equipment.

(b) Careless use of good equipment.

(c) Failure to check operating conditions of the apparatus.

(d) Failure to check plant thermometers against a Bureau of Standards thermometer.

(e) Failure to eliminate excessive foaming.

(f) Fluctuation in temperature due to manual control.

The deliberate class may be subdivided into:

(a) Deliberate dropping of temperature to 140° F. or lower in order to produce an apparently increased "cream line."

(b) Non-operation of agitators for the above reason.

(c) Cutting down on the holding interval so as to fill the plant flow sheet requirements during a temporary breakdown of part of the equipment.

(d) Laxity in operating conditions on the last run of milk.

(e) Deliberate omission of the holding period.

(f) Addition of raw milk to pasteurized milk in order to fill quota, or standardization of cream with raw milk.

(g) Uncontrolled foaming.

SUMMARY

A review of the literature is given and a rapid method is described for the control of pasteurization of milk, cream and related milk products. Enzymic hydrolysis of a subtrate is measured quantitatively by the addition of 2.6 dibromoquinonechloroimide resulting in indophenol blues of varying intensities if faulty pasteurization is present. The test can be completed in less than an hour and a half and will demonstrate such minor faults in technique of pasteurization as:

(1) A temperature of 1° F. below the 143° F. level required by the New York City Sanitary Code.

(2) Heating for 25 minutes instead of the required 30 minutes at 143° F.

(3) The addition of 0.5 per cent of raw milk to properly pasteurized milk or cream.

The method requires no special apparatus. It is inexpensive and may be used in plant control as an index of the efficiency of pasteurization. A method of reporting results in proposed phosphomonoesterase units is suggested.

A simple field test which can be completed in approximately ten minutes and which can be used by an inspector is reported which presents definite diagnostic value.

ACKNOWLEDGMENT

The author is indebted to Harry W. Raybin and Chemist-in-Charge Reginald Miller and to others of the Chemical Laboratory; to the Chiefs and Inspectors of the Milk Division of the Bureau of Food and Drugs of the New York City Health Department; and to Chemist Morris Paley of the WPA Library Staff.

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THE SURVIVAL OF PATHOGENIC MICROORGANISMS IN ICE CREAM

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The results of a study of the longevity of Brucella, Mycobacterium, and Salmonella species in ice cream has been reported previously by Wallace and Crouch.[1] In that study cultures of *Salmonella aertrycke, Salmonella enteritidis, Brucella abortus* Bang, *Brucella abortus porcine, Brucella melitensis, Mycobacterium tuberculosis hominis* (strains A, I & S), *Mycobacterium tuberculosis bovis* and *Mycobacterium avium* were inoculated and thoroughly mixed into vials of commercial ice cream and frozen at – 23.2° C. (– 10° F.). The Brucella and Salmonella species were put into the ice cream in the spring of 1930 and the Mycobacterium species in the fall of 1931. The vials containing Brucella and Salmonella species were held for 36 months and those containing Mycobacterium species for 30 months with periodic examinations to determine the viability of the inoculated organisms. At the end of those periods of storage all the species were found to be viable. A short review of the literature was also reported. Since that time Thompson[2] examined ice cream made from naturally infected cows' milk for the presence of Brucella. He found that the Brucella were carried into the ice cream during the manufacturing process and that they existed there for at least one month.

At the time of publication of the results by Wallace and Crouch there were a few vials of each series remaining, so it seemed desirable to continue holding them in storage to see how much longer the inoculated organisms would survive. Consequently, samples were examined in the spring of each year from 1934 through 1937. The same procedures mentioned in the first publication were again used. Where it was necessary to use animals three guinea-pigs were inoculated with each sample of ice cream.

The results, given in Table 1, do not seem to need very much discussion. Because the ice cream probably received a heavy inoculation of microorganisms and because commercial ice cream is made from pasteurized mix and is usually held for a few days only the practical importance of these results is not to be emphasized. However, it is interesting to observe that the microorganisms studied will survive for such a long time in ice cream at – 23.2° C. (– 10° F.).

Received for publication September 29, 1937.

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[2] Thompson, R. The isolation of *Brucella abortus* from ice cream. Canadian Med. Assoc. Jour. 29: 9. 1933.

TABLE 1

Showing the viability of microorganisms stored in ice cream

Year	1930–33	1934	1935	1936	1937
Years of storage	3	4	5	6	7
ORGANISMS					
Salmonella aertrycke	++	++	++	++	−
Salmonella enteritidis	++	++	++	++	+
Brucella abortus Bang	++	++	++	++	++
Brucella abortus porcine	++	+	−	−	−
Brucella melitensis	++	++	+	−	−
Mycobacterium tuberculosis hominis A	++	++	++	++	++
Mycobacterium tuberculosis hominis I	++	++	++	++	++
Mycobacterium tuberculosis hominis S	++	++	++	++	++
Mycobacterium tuberculosis bovis	++	++	++	++	++
Mycobacterium avium	++	++	++	−	−

++ in Salmonella = numerous colonies on culture.
++ in Brucella and Mycobacterium = all animals positive.
\+ in Salmonella = few colonies on cultures.
\+ in Brucella and Mycobacterium = at least one animal positive.
− = no viable organisms demonstrated.

SUMMARY

Salmonella enteritidis and *Brucella abortus* Bang have survived storage in ice cream at a temperature of −23.2° C. (−10° F.) for 7 years. Of the remaining organisms *Mycobacterium tuberculosis hominis* (strains A, I & S) and *Mycobacterium tuberculosis bovis* have survived for 6½ years, *Salmonella aertrycke* for 6 years, *Brucella melitensis* for 5 years, *Mycobacterium avium* for 4½ years and *Brucella abortus porcine* for 4 years. It should be made clear that *Salmonella enteritidis, Brucella abortus* Bang, *Mycobacterium tuberculosis hominis* (strains A, I & S) and *Mycobacterium tuberculosis bovis* were still viable and that later tests will be necessary to determine their longevity.

THE FUNCTIONAL ACTIVITY OF THE RIGHT AND LEFT BOVINE OVARY[1]

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The statement is made quite frequently that the right ovary of the bovine ovulates more frequently than the left ovary. However, very meager data are presented in support of the statement.

For a review of the earlier reports on the alternating action of the ovaries the reader is referred to Hammond (1). During the years 1907 to 1915 Stalfors (2) made rectal examinations of pregnant cows for the purpose of determining in which horn of the uterus the fetus was carried. Out of a total of 923 cows examined, 577 (62.5 per cent) carried the fetus in the right horn of the uterus and 346 (37.5 per cent) in the left horn. One hundred and five of these cows were kept under observation for two successive gestation periods and in 62 cows the fetus was twice carried in the same horn. Hammond (1) observed that in 65 per cent of the animals he examined the follicle ripened in the opposite ovary to that in which the previous ovulation occurred. Investigators at the Idaho Agricultural Experiment Station (3) reported that out of 146 pregnancies, determined by rectal examination and later proved positive by calf birth, 93 (64 per cent) took place in the right horn of the uterus, and 53 (36 per cent) in the left horn.

Clark (4) made observations on cattle from 8 to 12 weeks in gestation by rectal palpation of the uterine horns, ovaries, and middle uterine arteries. He found that in 704 cases of single pregnancy 293 (42 per cent) were in the left uterine horn and 411 (58 per cent) in the right uterine horn. In none of the cases observed by Clark was there evidence of migration of the fertilized ovum into the uterine horn opposite the site of origin.

Casida, Chapman, and Rupel (5) made an extensive study of the genitalia of heifer calves. The mean weight of the right ovary from 190 calves of Holstein appearance was $1.01 \pm .05$ grams, the mean weight of the left ovary was $0.89 \pm .04$ of a gram. In calves of other breeds the mean weights of the ovaries were: right $1.12 \pm .08$ grams; left, $1.03 \pm .08$ grams. They found a significant difference in the total follicular volume of follicles 4 to 13 mm. in diameter between the right and left ovaries, the right having the greater value.

In a recent study (6), cattle pituitary glands were collected in a local slaughter house and during this time we were also given the opportunity of collecting the ovaries. Inasmuch as it had been reported that more pregnancies occurred in the right horn than occurred in the left horn it was

Received for publication September 30, 1937.

[1] Contribution from the Department of Dairy Husbandry, Missouri Agricultural Experiment Station, Journal Series No. 532.

thought that if a large number of ovaries were collected from sexually mature non-pregnant animals, one would find the corpus luteum of estrum present more frequently in the right ovary than in the left ovary. That is, if the cause of the difference in the number of pregnancies in the right and left uterine horn was due to a difference in the functional activity of the right and left ovary. In addition, in cases of pregnancy the corpus luteum of pregnancy could be determined. Accordingly, ovaries were collected and they were weighed and examined for the presence of the most recent corpus luteum or the largest follicle.

A summary of our records showed that the greater functional activity of the right ovary was apparent before the heifer reached sexual maturity. Of 136 sexually immature heifers the largest follicle occurred in the right ovary in 100 cases (73.5 per cent) and in the left ovary in 36 cases (26.5 per cent). The average weight of the right ovary was 2.71 grams and that of the left ovary was 2.29 grams.

The ovaries from 98 sexually mature non-pregnant heifers were collected. Of this number the right ovary contained the corpus luteum of estrum in 59 cases (60.2 per cent) and the left ovary in 39 cases (39.8 per cent). The average weight of the right ovary was 5.53 grams and that of the left ovary was 4.82 grams.

Ovaries from 59 pregnant cows were collected and of this number the corpus luteum of pregnancy was found in the right ovary in 39 cases (66.1 per cent) and in the left ovary in 20 cases (33.9 per cent). In all cases the corpus luteum of pregnancy occurred on the same side as the pregnant uterine horn. The results are summarized in Table 1.

TABLE 1

The weight of bovine ovaries

GROUP	NO. OF ANIMALS REPRESENTED	PER CENT	AVERAGE WEIGHT OF RIGHT OVARY GM.	AVERAGE WEIGHT OF LEFT OVARY GM.
Ovaries from sexually immature heifers	136		2.71	2.29
Largest follicle in right ovary	100	73.5	2.91	2.14
Largest follicle in left ovary	36	26.5	2.16	2.73
Ovaries from sexually mature, non-pregnant heifers	98		5.53	4.82
Most recent corpus luteum in right ovary	59	60.2	6.64	3.48
Most recent corpus luteum in left ovary	39	39.8	4.00	6.85
Ovaries from pregnant heifers and cows	59		6.91	4.88
Corpus luteum of pregnancy in right ovary	39	66.1	8.69	4.32
Corpus luteum of pregnancy in left ovary	20	33.9	3.44	5.89

CONCLUSION

The right ovary of cattle is functionally more active than the left ovary and this difference in functional activity accounts for the greater number of pregnancies that occur in the right uterine horn than in the left horn.

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SOME OBSERVATIONS ON THE VITAMIN A VALUE OF BUTTER PRODUCED UNDER DROUGHT CONDITIONS[1]

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A few reports (1) appear in the literature on the vitamin A value of butter secured from cows on restricted rations. During the course of another investigation at the Kansas Agricultural Experiment Station samples of milk were collected for churning from the station Holstein herd whose normal feeding schedule has been considerably disturbed as a result of drought, leaving the herd without pasture during the usual pasture season. Commercial samples were also obtained from the station creamery at the same time for comparison. Other samples were available from an experimental group of grade Holsteins which had been maintained in dry lot on a restricted ration for over two years. It is the purpose of this paper to report the vitamin A value of butters produced under these unusual feeding conditions for comparison with known normal values.

METHODS

Twenty-four hour collections of milk were made from these groups of Holstein cows and butter was churned from the composites. Sample No. 1 was produced from the experimental cows on restricted ration in dry lot. Their ration consisted of upland prairie hay (about No. 2 grade) and a grain mixture made up of equal parts of white corn, wheat bran and cottonseed meal. Samples Nos. 2 and 3 were from the station herd collected in September and October respectively at the end of the abnormally dry summer of 1936. Little pasture had been available for several months to supplement the herd ration of alfalfa hay (approximately No. 2 grade), Atlas sorgo silage, and grain mixture made up of 400 pounds yellow corn, 200 pounds bran, 220 pounds oats, 100 pounds cottonseed meal, and 50 pounds linseed oil meal.

About the time that the foregoing samples were collected, samples Nos. 4 and 5 were secured from the station creamery. These had been churned from patrons' milk and represented feeding conditions somewhat similar to those under which the station herd was maintained.

Vitamin A content of the butter was estimated by measuring the absorption spectra at 328 mμ with a quartz spectrograph (courtesy of Physics Department, Iowa State College). The amount of beta carotene was determined spectrophotometrically at 480, 470, and 455 mμ with the application

Received for publication October 2, 1937.

[1] Contribution No. 74 from the Department of Home Economics, and Contribution No. 119 from the Department of Dairy Husbandry.

TABLE 1

Vitamin A value of butter produced under drought conditions

SOURCE OF BUTTER SAMPLE	SAMPLE NO.	DATE OF COLLECTION	VITAMIN A CONTENT PER GM. 328 Mμ		β-CAROTENE PER GRAM AVERAGE FROM 480, 470, 455 Mμ		TOTAL VITAMIN A VALUE PER GRAM	FAT YIELD PER COW	AVERAGE VALUE OF DAILY YIELDS
			Average per cent	*Average I.U.*	*Average per cent*	*Average I.U.*	*I.U.*	*gm.*	*1,000 I.U.*
Holstein experimental ration	1	9/9/36	.000646	10.08	.000081	1.34	11.42	290	4
Holstein herd ration	2	9/3/36	.001053	16.43	.000211	3.50	19.93	556	13
	3	10/19/36	.000864	13.48	.000326	5.31	18.79	419	9
Commercial samples	4	8/29/36	.000978	15.26	.000269	4.46	19.72	.....	.....
	5	10/19/36	.000771	12.03	.000419	6.95	18.98	.....	.....

of Peterson's (2) extinction coefficients. Results of the summation were computed and expressed as International Units of vitamin A value per gram of butterfat (Table 1). This method of determining vitamin A value of butter has been found by Leuschen *et al.* (4) to give results which check findings secured by the single feeding biological method.

DISCUSSION

The total vitamin A value of butter produced by the experimental herd on the restricted ration for over two years (Table 1) was the lowest for the samples tested. It contained approximately 11 I.U. per gram, or less than one-fourth the figure for butter computed by Sherman (3). The vitamin A value contributed by beta carotene in this sample was particularly low, averaging only about 30 per cent of that in the herd samples (Nos. 2 and 3). This low figure can be attributed to the absence of green feed or pasture in the ration of these cows and the presumably lower quality of the hay consumed. The September and October samples collected from the station Holstein herd at the end of the abnormally dry summer also showed low vitamin A values, averaging only about one-half those given for butter in the Sherman tables. These cows had received very little pasture since the previous spring. Summer temperatures also were the highest on record, which may have had some influence on vitamin A metabolism. While they were fed a ration typical of good barn feeding conditions, the hay and silage were of lower quality than in more normal years. This undoubtedly was true of much of the roughage harvested over extensive areas of the country seriously affected by the drought. In the total vitamin A value the butter runs considerably below computed average values (3) representative of good feeding. The question may be raised whether under drought conditions with much of the roughage fed of poor quality, the vitamin A value of the milk and butter produced is so reduced as to call for additional safeguards in human dietaries. At the time the October samples were collected, the cows had access to wheat and rye pasture for short intervals over a period of 10 days. This is reflected in the more than 50 per cent increase in the percentage of carotene, though with no increase in the total vitamin A value. The explanation for this is not known. In many experiments, a close correlation has been observed between the carotene content and vitamin A value of the milk fat. This does not always appear to hold true, however, Loy *et al.* (5) have observed that under certain conditions, especially those which affect the utilization of the vitamin of the ration or interfere with the vitamin A metabolism of the cow, there may be little or no correlation between carotene content and vitamin A activity of butterfat. The commercial samples which were produced under somewhat the same feeding conditions showed similar behavior and values closely approximating those for the station herd. The vitamin A value of the average daily yield of milk per cow also was calculated

(Table 1). This shows that in terms of total production the experimental herd with the lower level of milk production had lowest total daily yield of vitamin A value, averaging less than half the yields of the herd Holsteins.

SUMMARY AND CONCLUSIONS

Vitamin A values, determined by physical-chemical methods, are reported for butter samples produced under drought conditions. One group of Holstein cows had been maintained in dry lot for a period of two and a half years on a ration of prairie hay (approximately No. 2 upland) and grain mixture made up of equal parts white corn, wheat bran, and cottonseed meal. Other samples were secured from the station Holstein herd after the abnormally dry summer of 1936 This herd had received a ration of alfalfa hay, sorgo silage and a grain mixture with very little pasture since the previous spring. Values are also reported for commercial samples churned about the same time in the college creamery from patrons' milk produced under somewhat similar feeding conditions.

The vitamin A value of the butter produced by the experimental herd in dry lot was approximately 11 I.U. per gram or less than one-fourth the values computed by Sherman for butter produced under good feeding conditions. The vitamin A value of the beta carotene of this sample averaged only 30 per cent of the station herd samples.

The samples from cows in the station Holstein herd following the abnormally dry summer of 1936 showed vitamin A values averaging approximately one-half normal figures.

Commercial samples secured at the same time and produced under similar feeding conditions gave comparable values.

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THE ACTION OF HERRING OIL BEFORE AND AFTER HYDROGENATION ON THE YIELD AND FAT PERCENTAGE OF THE MILK OF THE GOAT[1]

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When small amounts of cod-liver oil are included in the diets of lactating cows, there is a subsequent decline in the fat percentage of the milk which they secrete. This was first pointed out by Golding and his associates (1), and has since been amply substantiated by Petersen (2) and McCay and Maynard (3).

Recently Golding (4) has shown that the factor or factors in cod-liver oil which cause this decline in fat percentage are not recovered in the non-saponifiable fraction of the oil. McCay and Maynard (3) have shown that the principle responsible for the phenomenon is located in the saponifiable fraction of the oil. In other words, some fatty acid or groups of fatty acids is responsible.

McCay and Maynard fed not only cod-liver oil but shark and salmon oil. These, however, produced an effect that was much smaller than that experienced with cod-liver oil.

In the light of these findings it would appear that the fatty acid group responsible for the reaction would be present in other fish oils but possibly in smaller quantities. The reaction, if of general biological importance, should be manifest in other species. Other highly unsaturated fatty acids will not produce a similar effect in lowering the percentage of fat in the milk. However, this does not necessarily mean that certain groupings of unsaturated bonds possibly occurring in the fatty acids of cod-liver oil are not responsible for the phenomenon. If this were true, hydrogenation of the fatty acids would obliterate the effect as produced by the untreated fish oil.

EXPERIMENTAL

Six lactating goats were used in the experiment, which was continued over a period of 11 weeks. The animals were divided into two groups and their ration supplemented as shown in Table 1 with herring oil and the same oil after hardening by hydrogenation.

The animals were confined to their stalls throughout the experiment. The milk secreted was measured to the nearest 5 cc. and milk fats were determined

Received for publication September 25, 1937.

[1] Contribution from the Department of Dairy Husbandry, Missouri Agricultural Experiment Station, Journal Series No. 529.

[2] The author wishes to thank the General Education Board of the Rockefeller Foundation for financial support.

TABLE 1
Showing the fat supplement to the daily diet

GROUP	WEEK				
	1–3	3–5	6	6–9	9–11
1	Control	2 oz. A	2 oz. B	2 oz. B	2 oz. B
2	Control	2 oz. B	2 oz. A	2 oz. A	2 oz. B

A—Original herring oil.
B—Hydrogenated herring oil.

on the milks of each animal twice weekly from a composite sample made up by taking aliquots from each milking. The original plan of experiment called for a mixture of the fat in the diet. However, while the goats consumed their ration containing the hardened oil with their usual appetite, they refused the mixture containing the original oil. Consequently, this was fed by syringe throughout the experiments.

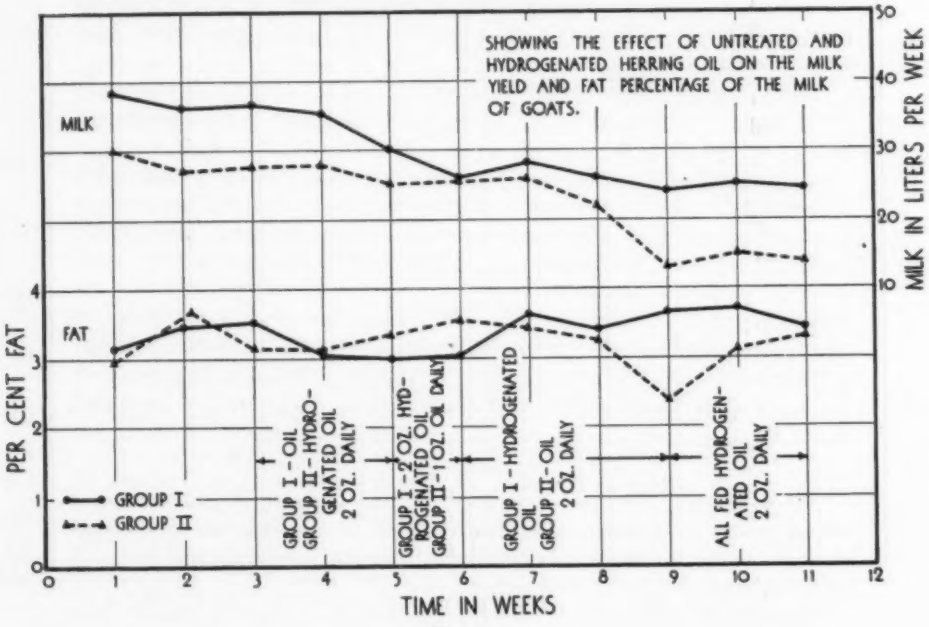
SHOWING THE EFFECT OF UNTREATED AND HYDROGENATED HERRING OIL ON THE MILK YIELD AND FAT PERCENTAGE OF THE MILK OF GOATS.
MILK
FAT
PER CENT FAT
MILK IN LITERS PER WEEK
TIME IN WEEKS
GROUP I
GROUP II
GROUP I - OIL
GROUP II - HYDROGENATED OIL 2 OZ. DAILY
GROUP I - 2 OZ. HYDROGENATED OIL
GROUP II - 1 OZ. OIL DAILY
GROUP I - HYDROGENATED OIL
GROUP II - OIL 2 OZ. DAILY
ALL FED HYDROGENATED OIL 2 OZ. DAILY

FIG. 1.

The condensed results are shown in Table 2 and Figure 1. These demonstrated that when 2 ounces of herring oil were fed daily there was a subsequent reduction in the percentage of fat in the milk produced by these animals. Similar amounts of the same fat after hydrogenation had little

TABLE 2

Showing the condensed results for milk yield and percentage of fat

GOAT NO.		WEEK										
		1	2	3	4	5	6	7	8	9	10	11
						Group 1						
123	Milk (cc.)	16,705	15,290	14,660	12,520	11,720	11,530	11,570	10,150	9,980	9,480	10,120
	Fat %	3.60	4.11	4.21	3.85	3.76	3.50	4.17	4.15	4.38	4.19	3.86
30	Milk	9,495	8,625	9,130	8,120	6,750	5,830	6,920	6,840	5,320	6,840	5,390
	Fat %	2.24	2.65	2.65	2.30	2.18	2.15	2.70	2.31	2.50	2.49	2.72
119	Milk	12,480	12,370	12,920	12,700	11,390	9,430	10,130	9,810	9,090	9,820	9,270
	Fat %	3.18	3.25	3.39	3.22	2.975	3.10	3.70	3.40	3.61	3.766	3.49
	Mean											
	Milk	36,860	36,285	36,710	35,340	30,860	26,970	28,620	26,700	24,390	25,140	24,780
	Fat %	3.13	3.47	3.53	3.05	3.00	3.06	3.64	3.41	3.67	3.73	3.47
						Group 2						
256	Milk	9,740	8,960	9,280	9,240	8,560	9,130	9,340	7,740	7,260	8,230	4,510
	Fat %	3.16	3.99	3.15	3.45	4.139	3.85	4.10	3.06	3.37	3.59	3.81
252	Milk	10,130	9,390	9,290	9,500	9,250	8,810	9,180	8,320	4,890	3,265	5,710
	Fat %	3.48	3.62	3.86	3.46	3.284	3.60	3.08	2.39	2.93	3.83	3.27
507	Milk	10,120	8,845	9,410	9,480	8,380	8,840	8,430	6,870	1,504	3,850	4,920
	Fat %	2.3	2.76	2.60	2.59	2.626	2.90	2.35	1.66	2.60	2.47	2.31
	Mean											
	Milk	29,990	27,195	28,050	28,220	26,190	26,780	26,990	22,950	13,654	15,345	14,200
	Fat %	2.97	3.68	3.19	3.16	3.349	3.45	3.205	2.395	3.13	3.36	3.34

or no effect on the percentage of milk fat. In fact, if any change occurred, there may have been a slight increase under this condition of feeding.

The results show that hydrogenation of the herring oil destroyed its power to reduce the percentage of fat in the milk. This fact indicates that the factor or factors responsible for the reaction are in unsaturated bonds of the fish oils. Since, however, simple unsaturation has been shown to produce no similar effect, the results must be due to some particular grouping of unsaturated bonds in these fatty acids.

The treatment with herring oil was, however, not without effect on the general well-being of the animals. This did not become apparent until the animals had been on feed for over two weeks. At that time they began to refuse their feed and the decline in milk production and fat percentage manifest in the earlier portions of the period became more pronounced. No difficulties were experienced when the animals were fed the supplements of hardened fat.

The reductions shown in the volume of milk secreted when the oil was fed are thus complicated by reduced feed intake. However, under similar conditions without the fish oil in the diet we would expect, on the basis of our knowledge of fat production, that there would have been an increase in the fat percentage of the milk.

The effect produced when the oil was fed appeared to be generalized through the body rather than localized in the secretion of the mammary gland. The toxicity of the untreated oil as compared to the same oil after hydrogenation indicates that the grouping of unsaturated bonds is reacting with some mechanism which is of general importance to the animal as a whole rather than one which might be specifically related to the secretion of milk.

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American Dairy Science Association Announcements

To Members of the American Dairy Science Association:

Each year your Association has been making progress by extending or enlarging its activities. The progress that has been made is due to the interest and support the Association has received from its individual members and it seems desirable at this time to call the members' attention to certain activities of the Association which are in need of some extra effort on the part of the members of the Association. Since the members of the Association meet only once a year, it is not always possible for the officers and directors to secure the advice and suggestions that are often badly needed in conducting the affairs of the Association; however, a listing of a few of the things that are being considered by the officers of the Association may suggest to you a means by which you can best serve your Association.

The December number of the Journal contains a list of members and subscribers by states and it is hoped that the members in each of these states will check this list and either make an effort to secure others, who would be benefited by becoming members of this Association or subscribers to the Journal, or inform the secretary of such prospective members.

The Journal management has been able to make another improvement. The March issue of the Journal will contain the production abstracts which it has not conducted before. This will, however, increase the cost of publishing, and an increase in membership or subscriptions will be especially desirable in keeping the Journal on a sound financial basis.

The membership should be considering nominations for the Borden Award for 1938, which will be for work completed and published during the five-year period, ending December 31, 1937. Nominations are to be considered for the most outstanding research work in the production field —breeding, feeding, farm sanitation, or quality production, and for outstanding research in the process field, such as improvement in equipment or methods in the handling of milk or cream and the production of milk products. Anyone who is a citizen of the United States or Canada and has not reached his fortieth birthday is eligible.

A committee has been appointed to bring the by-laws and constitution of the American Dairy Science Association up to date and make revisions where it is thought desirable. Professor S. M. Salisbury, Ohio State University, Columbus, Ohio, is chairman of this committee and will welcome suggestions from the membership in regard to desirable changes of the by-laws and constitution.

Plans are now in process for the annual meeting which will be held on the campus of Ohio State University, Columbus, Ohio, June 14 to 17, 1938.

The program committee has been appointed and the chairman, Dr. T. S. Sutton of Ohio State University will appreciate suggestions from members regarding the 1938 program.

There are very few members of the Association who cannot give some valuable assistance or suggestions on one or more of the above items and by doing so will contribute to the progress and increased usefulness of the Association. I can assure you that your assistance will be greatly appreciated by the officers and chairmen of these different committees.

Yours very truly,

H. W. GREGORY, *President*

STUDENTS' NATIONAL CONTEST IN JUDGING DAIRY PRODUCTS

Ohio State University again won highest honors in the Students' Dairy Products Judging Contest held at the Dairy Industries Exposition in New Orleans, October 25, 1937. Last year that institution gained permanent possession of the silver cup awarded the team winning first place in judging all products, having won it three times.

In the judging of ice cream, the members of the Ohio team won first, second, and third places, which is a record performance. In the judging of other products, however, teams from other institutions carried off all the silver cups and medals. The University of Nebraska won first in judging butter, South Dakota State College first in the judging of milk, and the University of Minnesota first in the judging of cheese. Teams from seventeen colleges competed.

The scholarships which are awarded to the institutions represented by the teams winning the first six places in judging all products were won by Ohio State University, Mississippi State College, Massachusetts State College, Michigan State College, University of Minnesota, and Cornell University. The scholarships are provided annually by the Dairy and Ice Cream Machinery and Supplies Association.

That Association also provides five silver cups which are awarded to the team scoring first in judging all products and the teams winning first place in the judging of butter, cheese, milk, and ice cream.

Gold, silver, and bronze medals are also awarded by that Association to the individual contestants who win first, second, and third places, respectively, in judging each product and all products.

The International Association of Milk Dealers awarded a gold medal to the winning contestant in judging milk, and the International Association of Ice Cream Manufacturers awarded a gold medal to the winning contestant in judging ice cream.

Mr. William White of the Bureau of Dairy Industry, United States Department of Agriculture, again served as Superintendent of the contest. The official judges were: butter, L. S. Edwards; cheese, H. L. Wilson; ice cream, A. C. Dahlberg; and milk, C. J. Babcock.

Following are the teams and individuals who won high standings in the contest:

ALL PRODUCTS

Teams		*Individuals*	
1—Ohio State University	319.60	1—Dan C. Roahen, Ohio State University	97.20
2—Mississippi State College	324.85	2—Henry A. Lardy, South Dakota State College	102.95
3—Massachusetts State College	333.95	3—Brooks Naylor, University of Minnesota	103.05
4—Michigan State College	336.70	4—M. Putnam, Mississippi State College	103.50
5—University of Minnesota	342.50	5—William B. Graham, Massachusetts State College	104.10
6—Cornell University	348.95		

ICE CREAM

Teams		*Individuals*	
1—Ohio State University	72.75	1—Dan C. Roahen, Ohio State University	21.75
2—Cornell University	94.75	2—George E. Neeley, Ohio State University	24.75
3—Michigan State College	99.25	3—J. Atlee Miller, Ohio State University	26.25
4—Massachusetts State College	107.25	4—H. Webster, Cornell University	27.25
5—Louisiana State University	116.40	4—Henry A. Lardy, South Dakota State College	27.25

BUTTER

Teams		*Individuals*	
1—University of Nebraska	52.25	1—Wayne Klamm, Kansas State College	9.50
2—Mississippi State College	55.75	2—Oakley Larson, University of Nebraska	14.75
3—University of Minnesota	58.00	3—Don Radenbaugh, University of Nebraska	15.00
4—Iowa State College	58.50	4—William B. Graham, Massachusetts State College	16.00
5—Michigan State College	65.50	5—Howard G. Dissly, Cornell University	16.50

MILK

Teams		*Individuals*	
1—South Dakota State College	67.45	1—David Henry, South Dakota State College	14.15
2—Mississippi State College	70.85	2—Robert D. MacCurdy, Massachusetts State College	16.80
3—Texas Technological College	72.70	3—Clement C. Schmiego, University of Wisconsin	19.30
4—Massachusetts State College	76.20	4—George H. Fenner, Iowa State College	19.45
5—University of Wisconsin	79.00	5—M. Putnam, Mississippi State College	20.50

CHEESE

Teams		*Individuals*	
1—University of Minnesota	67.50	1—Rudolph P. Zelm, University of Wisconsin	18.50
2—Mississippi State College	70.75	2—Brooks Naylor, University of Minnesota	21.00

3—Massachusetts State College	72.00	2—William B. Graham, Massachusetts State College	21.00
4—Iowa State College	80.50	4—J. B. Maury, Jr., Mississippi State College	21.25
5—Cornell University	80.75	5—Williams Welles, Michigan State College	22.00
		5—Goodwin Sonstegard, University of Minnesota	22.00

COLLEGIATE DAIRY CATTLE JUDGING CONTEST

The Collegiate Dairy Cattle Judging Contest, held at the National Dairy Show in Columbus, Ohio, was operated under the rules approved by the committee of the American Dairy Science Association consisting of Drs. I. W. Rupel, J. R. Dice, P. M. Reaves, and J. F. Kendrick. Fifteen rings of animals were judged. Two rings of four animals each and one ring of six or more animals were selected for each breed. A committee was selected by the superintendent, Burt Oderkirk, to select the rings, and he appointed five official breed judges who worked with the entire group of coaches in placing the classes. This year a single judge for each breed graded the reasons. The judges and breed of cattle judged are as follows:

Holsteins—L. S. Gillette, Fostoria, Iowa.

Guernseys—O. G. Schaefer, Meredith Publications, New York.

Ayrshires—Jack Nesbit, Hoard's Dairyman, Ft. Atkinson, Wis.

Jerseys—Frank Astroth, S. St. Paul, Minn.

Brown Swiss—L. H. Fairchild, Allied Mills, Omaha, Nebr.

The American Jersey Cattle Club again awarded a $400.00 scholarship to the high ranking contestant in judging Jerseys to apply on graduate work in dairy husbandry. Cups and other trophies were awarded by the breed association and commercial companies. Significant, according to the judges of the contest who had judged the contest several years ago, was the absence of poorly trained teams, which would indicate that livestock judging instruction has been strengthened in many institutions.

Following are the teams and individuals who won high standings in the contest:

ALL BREEDS

Teams		*Individuals*	
1—Texas A. & M. College	5365.9	1—S. R. Aldrich, Michigan	1818.4
2—Oklahoma A. & M. College	5243.7	2—M. Underwood, Purdue	1802.7
3—Purdue University	5217.4	3—R. Nelson, Wisconsin	1802.6
4—Michigan State College	5214.1	4—J. Bradley, Texas A. & M.	1797.9
5—Kansas State College	5191.5	5—B. B. Hodgins, Ontario	1797.4

AYRSHIRES

Teams		*Individuals*	
1—Texas A. & M. College	1145.6	1—J. W. Bradley, Texas A. & M.	394.6
2—University of Missouri	1124.7	2—Warren Westbrook, Missouri	390.4
3—University of Tennessee	1102.9	3—N. C. Fry, Texas A. & M.	388.6
4—Pennsylvania State College	1093.3	4—Loyol Corman, Nebraska	384.6
5—Cornell University	1087.1	5—Alfred Durand, Pennsylvania	384.0

BROWN SWISS

Teams		*Individuals*	
1—Michigan State College	1137.6	1—N. C. Fry, Texas A. & M.	390.7
2—Texas A. & M. College	1102.6	2—C. Weaver, Michigan	389.2
3—University of Wisconsin	1091.8	3—Wilson Jones, Tennessee	382.6
4—Purdue University	1040.5	4—S. R. Aldrich, Michigan	379.0
5—Ohio State University	1036.6	5—Robert Van Liere, Wisconsin	378.8

GUERNSEYS

Teams		*Individuals*	
1—University of Maryland	1061.1	1—Frank McFarland, Maryland	372.0
2—Oklahoma A. & M. College	1053.3	2—J. B. Outhouse, New York (Cornell)	367.4
3—Ontario Agr. College	1040.6	3—Ernest Zehner, Ohio	364.0
4—University of Missouri	1040.0	4—Loyol Corman, Nebraska	363.1
4—University of Nebraska	1040.0	5—Everett Danney, Ohio	261.9

HOLSTEINS

Teams		*Individuals*	
1—Texas A. & M. College	1076.1	1—R. Nelson, Wisconsin	375.6
2—University of Wisconsin	1062.9	2—M. Jones, Texas A. & M.	373.9
3—University of Nebraska	1059.9	3—V. Brown, Iowa	372.7
4—Oklahoma A. & M. College	1059.3	4—W. Englund, Nebraska	370.6
5—University of Missouri	1043.3	5—B. B. Hodgins, Ontario	367.0
		5—B. Bennett, Oklahoma	367.0

JERSEYS

Teams		*Individuals*	
1—Kansas State College	1097.1	1—Forest Fansher, Kansas	385.2
2—Texas A. & M. College	1087.3	2—R. Nelson Phelps, Maryland	378.4
3—University of Maryland	1080.8	3—Clyde Chappell, Tennessee	377.6
4—University of Tennessee	1075.8	4—S. R. Aldrich, Michigan	375.6
5—Oklahoma A. & M. College	1072.9	5—Vernon Baldwin, Minnesota	372.0

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VOLUME XXI JANUARY, 1938 NUMBER 1

JOURNAL OF DAIRY SCIENCE

Published by the

AMERICAN DAIRY SCIENCE ASSOCIATION
R. B. STOLTZ, Ohio State University, Columbus, Ohio, Sec.-Treas.

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Published in cooperation with

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THE SCIENCE PRESS PRINTING COMPANY LANCASTER, PA.

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Zeitschrift für Physikalische Chemie, Abt. A and B
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SPECIAL PUBLICATIONS

Federal Dairying and Bacteriological Establishment, Liebefeld, Berne, Switzerland

International Association of Ice Cream Manufacturers
International Association of Milk Dealers
International Association of Milk Inspectors

National Dairy Experiment Station, Hillerod, Denmark
National Institute for Research in Dairying, Reading, England

New York Association of Dairy and Milk Inspectors

Prussian Dairy Research Institute, Kiel, Germany

State Agricultural Colleges and Experiment Stations

The Royal Technical College, Copenhagen, Denmark

United States Department of Agriculture

ABSTRACTS OF LITERATURE ON MILK AND MILK PRODUCTS

BACTERIOLOGY

1. **Mastitis.** K. G. Weckel, Univ. of Wisconsin, Madison, Wisconsin. Nat. Butter and Cheese J. *28,* 12, p. 10, June 25, 1937.

The severity of this infection of the udder determines the amount and condition of milk secreted. Differences in twenty-three properties of milk from normal and infected udders are tabulated and their possible effects on cheese are discussed. Various tests for detecting mastitis are described. Suitable precautions in applying the tests are suggested. W.V.P.

2. **Methods for Differential Staining for Dead and Living Bacteria.** Eugen P. Nadelin, Wooster, Ohio. Milk Dealer *26,* 10, p. 35, July, 1937.

The author reviews the literature and reports his findings on methods for differential staining for dead and living bacteria. C.J.B.

3. **Comparison of Solid with Liquid Media as a Means of Determining the Presence of Lactose Fermenting Bacteria in Pasteurized Milk.** M. W. Yale, N. Y. Agr. Exp. Sta., Geneva, N. Y. Am. J. Pub. Health *27,* 6, 1937.

A comparison of 11 agar media showed that desoxycholate and violet red bile agar were best suited for the examination of pasteurized milk. The conditions under which it is of value to use a solid rather than a liquid medium and the significance of the red acid forming colonies which develop upon desoxycholate and violet red bile agar plates are discussed M.W.Y.

BUTTER

4. **Paying for Milk in Whole Milk Creameries.** H. C. Jackson, Univ. of Wisconsin, Madison, Wis. Nat. Butter and Cheese J. *28,* 8, p. 34, April 25, 1937.

Distribution of creamery receipts on the straight-fat basis is satisfactory, even when by-products are made into dry milk, if milk tests of individual patrons do not vary widely from the plant average. When tests vary widely, an equitable method of payment is suggested which allows for differences in yield of dry milk; variations in costs of handling milk of different fat tests; and changing prices of dry milk. W.V.P.

5. **Cold Storage Lockers.** Anonymous. Nat. Butter and Cheese J. *28,* 8, p. 6, April 25, 1937.

Many creameries and cheese factories have found a cold storage locker

system a profitable sideline. Organization, type of equipment, freezing methods and outlook for the cold storage movement are described. W.V.P.

6. A Practical Solution to the Milk Hauler Problem. Anonymous. Nat. Butter and Cheese J. *28*, 10, p. 6, May 25, 1937.

A creamery company in Wisconsin leases trucking equipment to handle milk routes. Drivers who may be truck owners are hired to operate the trucks. Forms of contracts are shown. Reduction in costs of Workmen's Compensation Insurance and elimination of postage charges for sending checks and statements to patrons more than pay for the additional costs of Unemployment Insurance and Social Security taxes. W.V.P.

7. Controlling the Flavor of Butter. H. A. RUEHE, Dept. of Dairy Husb., Univ. of Ill., Urbana, Ill. Nat. Butter and Cheese J. *28*, 4, p. 20, Feb. 25, 1937.

Diacetyl is the cause of flavor and aroma in butter. The steam distillates from certain starters are rich in this butter flavor. Proper manipulations of starters increase the flavor yield. Distillate of standardized strength can be added to butter at salting at the rate of one part distillate to 200,000 parts of butter to produce a preferred flavor. The flavor thus produced seems to stand storage. The distillate is economical to use, but its addition to butter is illegal according to regulations of the Federal Food and Drug Administration. W.V.P.

8. Whole Milk Movement. Anonymous. Nat. Butter and Cheese J. *28*, 4, p. 6, Feb. 25, 1937, and *28*, 5, p. 6, March 10, 1937.

A survey of the Middle West indicates a general trend toward the delivery of whole milk to creameries. In Wisconsin, Minnesota and Michigan the trend is very definite; in Iowa, the Dakotas, Illinois, Kansas and Indiana the trends are noticeable. Some sources of information indicate that creameries are beginning to manufacture other types of dairy products, such as ice cream mix, evaporated milk and cheese. A map and a table are presented in the second article to show that the whole milk movement is a long time trend. W.V.P.

9. The Butter Outlook. H. A. Ross, Bureau of Economics, The Borden Co. Nat. Butter and Cheese J. *28*, 1, p. 6, Jan. 10, 1937.

The author discusses the effect on the butter market of such factors as: number of cows; the cow cycle; geographical distribution of cows; market milk surplus; crop conditions; demand for butter; and consumer purchasing power. Production is not keeping pace with population. Consumer purchasing power is increasing. The average price of butter during the next

two or three years will probably be higher than during the last three. Ross expects decreased production now but more cows and an over-supply of milk in a few years. W.V.P.

Other abstracts of interest are numbers 14, 27, 47, and 48.

CHEESE

10. Results of Treating Cheese Milk or Fresh Curds with Cured Cheese. J. C. MARQUARDT, N. Y. State Agr. Exp. Station, Geneva, N. Y. Nat. Butter and Cheese J. *28*, 11, p. 20, June 10, 1937.

Cured Roquefort, Limburger and Sap Sago cheese were added to milk to be used for cheddar cheese or to the cheddar curd during matting. Sap Sago produced a pleasing flavor characteristic of dried Melilotus caerulea when added to milk at the rate of one quarter per cent. One per cent of Roquefort or Limburger added to the milk caused little change in cheese score but five per cent added to the curd injured both body and flavor. W.V.P.

11. A Study of Sugaring Curds in the Manufacture of Cheddar Cheese. J. C. MARQUARDT, N. Y. State Agr. Exp. Station, Geneva, N. Y. Nat. Butter and Cheese J. *28*, 10, p. 14, May 25, 1937.

The addition of three quarters per cent cane sugar to ten experimental batches of cheddar cheese curd just before salting reduced the average moisture content of the cheese 1.1 per cent and increased the average score of the cheese in body 0.4 point and in flavor 0.4 point. The effect of sugar on quality may be due to decrease in moisture or to changes in curd structure, pH and bacterial influences. W.V.P.

12. Observations on European Cheese Production. J. C. MARQUARDT, N. Y. Agr. Exp. Sta., Geneva, N. Y. Nat. Butter and Cheese J. *28*, 3, p. 25, Feb. 10, 1937.

Laboratories and commercial plants were visited in Germany, Holland, Ireland and England. Developments in research and plant practice are reported. Observations of quality, manufacturing process, and composition of popular kinds of European cheese are given. W.V.P.

13. Methods for the Manufacture of Smoked Type Cheese. J. C. MARQUARDT, N. Y. Agr. Exp. Station, Geneva, N. Y. Nat. Butter and Cheese J. *28*, 9, p. 10, May 10, 1937.

The manufacture of smoked type cheese in the United States has been limited because of the involved technique when natural smoke is used. Liquid smoke (pyroligeneous acid) was used to impart smoked flavor by adding it, experimentally, at different stages of cheese making. Additions

of liquid smoke at the rate of 0.1 per cent to milk or to whey just after cutting produced a pleasant smoked flavor in cheddar and Provolona cheese. W.V.P.

14. Findings in Farm Science. Annual Report of the Director, 1935–36, Agr. Exp. Station, Univ. of Wisconsin, Madison. Bull. 438, March, 1937.

This bulletin briefly summarizes the newest findings of work just completed or in progress. The following sections are of interest to the dairy industry:—

Relation of abnormal milk to mastitis: E. G. Hastings, p. 40.

Studies of mastitis: F. B. Hadley, pp. 39, 41.

Cheese meal in pig rations: G. Bohstedt and J. M. Fargo, p. 50.

Learn how to make winter milk better: G. O. Kohler, *et al.*, p. 131.

Determine best conditions for growing Swiss cheese starter: W. C. Frazier and P. R. Elliker, p. 149.

Salting brick cheese: E. L. Byers and W. V. Price, p. 152.

Wrapper for processed cheese: H. L. Templeton and H. H. Sommer, p. 153.

Low cost milk pasteurizing equipment for cheese factories: W. V. Price and Z. D. Roundy, p. 154.

Composition of butterfat determines its stability toward oxidation: V. C. Stebnitz and H. H. Sommer, p. 156.

Research makes possible more efficient irradiation apparatus: H. H. Beck, K. G. Weckel and H. C. Jackson, p. 157.

Other abstracts of interest are numbers 46 and 48.

CONCENTRATED AND DRY MILK

Abstracts of interest are numbers 14, 15, 16, 27, 34, 45, 47, and 48.

FOOD VALUE

15. Milk and Health. A. D. Burke, Dairy Dept., Alabama Polytechnic Inst., Auburn, Ala. Milk Dealer *26*, 11, p. 31, Aug., 1937.

The author discusses the necessity, from a health standpoint, of milk in the diet. C.J.B.

16. Nutritional Economics of Dietary Calcium. Frank L. Gunderson, Nutrition Lab., The Quaker Oats Co., Chicago, Ill. Am. J. Pub. Health *27*, 6, p. 570, 1937.

Relative costs to the consumer of 1 gram of calcium are shown for foods relatively high in calcium content and for calcium pharmaceuticals. Milk consumption for a large proportion of the population is too low to supply

an adequate amount of calcium. The addition of calcium salts to certain foods consumed regularly by families on extremely low budgets would help significantly. M.W.Y.

17. A Safeguard Against Lead Poisoning. Anonymous. Milk Dealer *26*, 9, p. 78, June, 1937.

A brief discussion of how milk is an important method of combating lead poisoning. C.J.B.

ICE CREAM

18. Price-Cut Protection on Package Helps Entire Sales Program. Anonymous. Ice Cream Trade J. *33*, 7, p. 10, July, 1937.

The "Darlene" package is the patented name of a new package of ice cream recently introduced by the Philadelphia Dairy Products Co., Philadelphia, Pa. It contains 17½ fluid ounces of ice cream and weighs 12½ to 13 ounces. French vanilla is used in combination with (1) raspberry ice, chocolate, and fresh strawberry; (2) pistachio, cherry pecan, and chocolate-marshmallows; (3) strawberry ice, caramel fudge and pineapple; (4) mint ice, chocolate, and cherry custard. The shape of the package is hexagonal and four generous portions, each containing all four flavors, can be served from it. The minimum retail price, protected by manufacturer-dealer contract, is 29 cents at present. Coupled with the promotion of "Darlene" ice cream is a merchandising program designed to help each dealer increase his business. W.H.M.

19. Recent Developments in Ice Cream Research. Anonymous. Ice Cream Trade J. *33*, 7, p. 12, July, 1937.

This article describes the high lights of the recent meeting of the American Dairy Science Association held June 21–25 in Lincoln, Nebraska. Abstracts of papers dealing with ice cream and related subjects were presented. W.H.M.

20. "Sogo" Ice Cream. Thomas B. Harrison, Univ. of Tenn., Knoxville, Tenn. Ice Cream Trade J. *33*, 7, p. 29, July, 1937.

Sogo, abbreviation for sorghum, is the name of a new flavored ice cream developed at the University of Tennessee, Knoxville, Tennessee. The flavor is produced by the addition of 1 pound of especially prepared sorghum syrup to 5 gallons of regular ice cream mix in the freezer. According to the author, a delightful flavor somewhat like caramel and butterscotch is produced. W.H.M.

21. Merchandising for Greater Profits. Frederick A. Van Fleet. Anonymous. Ice Cream Trade J. *33*, 7, p. 30, July, 1937.

The Coulter Drug Store in Lakewood, Ohio, increased its ice cream sales from 2,790 gallons in 1933 to 13,500 in 1934, 14,000 in 1935, and 14,500 in 1936. This increase was accomplished by rearranging the store, and installation of new ice cream equipment. The store specialized in high grade, store filled packages, and increased the number of flavors sold from 4 to 24. Ice Cream sales increased from 5 to 15 per cent of the total sales in the store and general business in the store also increased about 15 per cent.

W.H.M.

22. Routing Orders to Customers. E. T. FOXENBERGH, Bloomer Bros. Co., Newark, N. Y. Ice Cream Trade J. *33*, 7, p. 34, July, 1937.

The centralization of traffic functions and placing them in charge of a traffic manager has made it possible to give better and more economical service to the customers of this concern. Savings were affected by the establishment of commodity rates, new classification ratings, transit privileges and combining less-than-carload shipments out to carload shipments.

W.H.M.

23. Preventing Flavor Defects in Ice Cream Caused by Fat Oxidation. C. D. DAHLE AND D. V. JOSEPHSON, Penn. State College, State College, Penn. Ice Cream Rev. *20*, 11, p. 31, June, 1937.

When copper was introduced into the ice cream mix at the rate of two p.p.m. to accelerate the development of oxidized flavor it was found that the addition of 0.5 to 0.7 per cent of oat flour of a fine mesh delayed or prevented the onset of the oxidized flavor for several weeks. When oat flour was added to fresh cream before being frozen for storage, a definite protection was afforded the ice cream made from the cream. The use of oat flour increased the body score of the ice cream.

J.H.E.

24. How to Produce Quality Ice and Sherbets. N. E. FABRICUS, Iowa State College, Ames. Iowa. Ice Cream Rev. *20*, 9, April, 1937.

Since the flavoring material used in an ice or sherbet is comparatively more important than the flavoring materials used in ice cream, its quality should be more carefully considered. In many cases there is a tendency to add too much flavor to sherbets, and in many cases fortified flavors are used. In a set of samples exhibited at the Iowa Convention the following flavor criticisms were most common: unnatural, acid, peel oil flavor, turpentine flavor, stale milk products.

Common defects, such as softening at ordinary cabinet temperatures, a fluffy body, and settling out of the concentrated syrups, are due in part to inadequate overrun control. This can best be overcome by freezing half batches.

J.H.E.

25. Sodium Alginate as a Stabilizer for Ice Cream. E. O. ANDERSON, L. R. DOWD, AND H. HELMBOLDT, Conn. State College, Storrs, Conn. Ice Cream Rev., *20*, 11, p. 88, June, 1937.

Sodium Alginate is as effective as gelatin as a stabilizer for ice cream. J.H.E.

26. Ice Cream Plant Layouts and Design. C. F. WEINREICH, Cherry-Burrell Corp., Chicago, Ill. Ice Cream Rev. *20*, 10, p. 56, May, 1937.

Detailed plans, including arrangement of equipment, are given for an ice cream plant manufacturing approximately 300,000 gallons annually. J.H.E.

27. Air Conditioning in the Ice Cream Plant. G. O. WEDDELL, York Ice Machinery Corp., Pittsburgh, Pa. Branch. Ice Cream Rev. *20*, 11, p. 36, June, 1937.

A year around air conditioning system cools and dehumidifies the air in summer, heats and humidifies the air in winter, cleans and circulates the air, and continuously adds to the system the desired amount of outside air brought in for ventilation. Various sections of the ice cream plant can be air conditioned to advantage. J.H.E.

Other abstracts of interest are numbers 2, 3, 5, 7, 9, 14, 15, 16, 33, 34, 45, 47, and 48.

MILK

28. The Relationship of Composition to Quality in Milk. II. J. C. MARQUARDT, N. Y. Agr. Exp. Station, Geneva, N. Y. The Goat World *21*, 7, Nov., 1936.

This study was made on samples of goat's milk collected throughout the United States in the second National Goat's Milk Scoring Contest. It is probable that the results apply to other milk.

As previously established fat, total solids, reaction, and curd tension did not affect the milk flavor scores. High lactose and low salt percentages were associated with high scores for flavor of goat's milk.

The reliability of determining the central tendencies using analyses at a given place over a long period as compared to gathering analyses over a scattered area for a brief period are discussed. J.C.M.

29. Some Economic Aspects of a Milk Quality Program. V. C. MANHART, Dept. of Dairy Husbandry, Purdue Univ., Agr. Exp. Station. Milk Dealer *26*, 9, p. 70, June, 1937.

Recognizing that quality control must, as a matter of necessity, vary with circumstances, the Dairy Department of Purdue University has recommended as a milk quality control program for general use in Indiana that (1) all milk be graded at the plant by the senses of taste and smell; (2) that milk objectionable in flavor or high in acid content should be rejected or paid for at a lower price; (3) that milk satisfactory on the basis of flavor should be subjected to the methylene blue and sediment tests at least twice a month—with flavor, of course being determined daily.

Testing this plan in Indiana it was found to result (1) in the milk plant receiving a better quality milk which sold at one cent a quart more than the prevailing pasteurized milk price in the market; (2) bacteria counts in pasteurized milk were reduced to less than 10,000 per cc.; (3) producers received 17 per cent more than the prevailing price paid in the territory.

C.J.B.

30. Homogenized Milk. Milk Dealer *26*, 9, p. 38, June, 1937.

A description of how homogenized milk was introduced to, and accepted by, the consumers of Elgin, Ill. C.J.B.

31. When Your Bottle Caps Become "The Talk of the Town." Milk Dealer *26*, 9, p. 43, June, 1937.

A description of how the Kennedy-Mansfield dairy of Madison, Wisconsin, uses the milk-bottle cap for advertising. C.J.B.

32. A Dentist Looks at the Milk Business. Bion R. East. Milk Dealer *26*, 9, p. 44, June, 1937.

The author enumerates the advantages of pasteurized milk and points out the reason for the existence of the raw milk fallacy. C.J.B.

33. Important Sources of Micro-Organisms in Milk and Other Dairy Products. H. H. Weiser, Dept. of Bact., Ohio State Univ. Milk Dealer *26*, 9, p. 46, June, 1937.

A brief discussion is given of the principal sources of micro-organisms in milk. C.J.B.

34. Simplifying the Cleaning Job in the Milk Plant. Anonymous. Milk Dealer *26*, 9, p. 50, June, 1937.

Description of a new device that utilizes steam to pick up and apply liquid sterilizers and cleaning solutions in the form of highly atomized and heated spray that can be controlled as to heat, pressure, and degree of moisture.

C.J.B.

35. Sour Cream. Anonymous. Milk Dealer *26*, 9, p. 60, June, 1937.

This gives the information obtained from a questionnaire to 150 leading dairies of the United States by the Owens-Illinois Glass Co. In addition to giving information as to type of container, names suggested other than sour cream, and demand, the questionnaire showed that 96 per cent of the dairies sell sour cream and 81 per cent sell it under that specific name. C.J.B.

36. This Orange Drink Business. Anonymous. Milk Dealer *26*, 9, p. 64, June, 1937.

A discussion of the present status of the orange drink business based on report from milk dealers in various sections of the country concerning antagonistic legislation, period of heaviest sales, best sales outlets, and the like. C.J.B.

37. Current Trends in Milk Consumption. . . . January–March, 1937. Edward Fisher Brown, Milk Research Council, Inc., New York, N. Y. Milk Dealer *26*, 9, p. 80, June, 1937.

The author gives a comprehensive report of the performance of the fluid-milk market in metropolitan New York, Boston, and Philadelphia during the period January–March, 1937. C.J.B.

38. Oxidized Flavor in Milk. L. M. Thurston, Univ. of Florida. Milk Dealer *26*, 9, p. 112, June, 1937.

The author discusses the oxidized flavor in milk as related to or affected by: (1) Contamination of milk with metals, (2) Micro-organisms and reducing agents, (3) Feed of the cow, (4) Effect of various processes, (5) Effect of sunlight. C.J.B.

39. Refrigerated Milk Delivery. Anonymous. Milk Dealer *26*, 10, p. 40, July, 1937.

A description of the insulated box units, that maintain nine cases of milk at 45° F. for 24 hours with 50 pounds of ice, as used on the retail delivery trucks of the Franklin Co-Operative Creamery Association of Minneapolis. C.J.B.

40. Dairy Plant Problems. Milton W. Lightcap, Maintenance Service Dept., Pittsburgh Plate Glass Co. Milk Dealer *26*, 10, p. 44, July, 1937.

The author briefly discusses moisture conditions, amount of light in the building, kind of building material used, type of construction involved, presence of acid in milk, necessity for daily washing, and other factors to consider before selecting a paint for a dairy plant. C.J.B.

41. Computation of Milk Products. HANS EDEL, Gehl's Guernsey Farm, Milwaukee, Wis. Milk Dealer *26*, 11, p. 24, Aug., 1937.

The author presents a method of standardizing milk products by the use of a chart. C.J.B.

42. One Cent Bottle Charge Solves Bottle Loss Problem for Sidney, Ohio, Dealers. Anonymous. Milk Dealer *26*, 10, p. 102, July, 1937.

An account of how (after failing to secure satisfactory results with a five-cent bottle charge) six of the eight milk dealers in Sidney, Ohio, organized as the Sidney Milk Bottle Association, introduced a one-cent bottle charge this year with the result that their bottle loss is only about one-third as great as it was a year ago. C.J.B.

43. Visiting a Pasteurized Milk Plant in Kiev, Russia. Anonymous. Milk Dealer *26*, 10, p. 54, July, 1937.

A description of a Russian pasteurized milk plant. Some of the conditions existing in Russia are also briefly described. C.J.B.

44. Inaugurating Grade A Pasteurized Milk in the City of Chicago. HERMAN N. BUNDESEN, President, Board of Health, Chicago, Ill. Am. J. Public Health *27*, 7, p. 260, 1937.

The formulation and enforcement of the standard milk ordinance of the U. S. Public Health Service adopted by the City of Chicago in January, 1935, are discussed. The sale of milk and milk products, including the ingredients of ice cream, was limited in Chicago to Grade A pasteurized and certified milk and milk products. The author feels that there has been a decided improvement in the milk supply since the ordinance was adopted and that producers, distributors and consumers are satisfied with the results. M.W.Y.

45. Sterilization by Radiation. A. R. DENNINGTON, Westinghouse Lamp Co., Bloomfield, N. J. Ice Cream Rev. *20*, 12, p. 31, July, 1937.

The author states that radiation of milk on an experimental basis has shown that about 98 per cent sterility can be obtained by treating the milk in a thin film for 40 seconds and this treatment did not change the taste. For a given expenditure of radiant energy the most effective radiation is in the region of 2,537 Ångstroms and down to 2,000 Ångstroms or even less. J.H.E.

46. Plastic Cream and Its Uses. L. P. SHARPLES, Milk Processes, Inc., Philadelphia, Pa. Milk Dealer *26*, 11, p. 44, Aug., 1937.

A description of plastic cream, how it is made, and its uses. The author gives the following uses for plastic cream: A cheap means of transporting cream, A cheap means of storing cream, For making ice cream, For making cream cheese without bag draining, For making cheese by the standard methods, For making fluid cream, For making flavored spreads, For making butter. C.J.B.

Other abstracts of interest are numbers 1, 2, 3, 6, 8, 14, 15, 16, 17, 27, 46, 47, and 48.

MISCELLANEOUS

47. Accident Prevention Program. Milk Dealer *26*, 11, p. 35, Aug., 1937.

A description of the safety program of Metzer Dairies of Dallas, Texas. This program uses both a bonus and penalty plan. C.J.B.

48. Legal Problems for the Plant Manager. Leo T. Parker, Attorney at Law, Cincinnati, Ohio. Ice Cream Trade J. *33*, 7, p. 37, July, 1937.

This article deals with the legal problems which confront owners and managers of ice cream plants. Proper conducts of business will make it possible to avoid any legal controversies. W.H.M.

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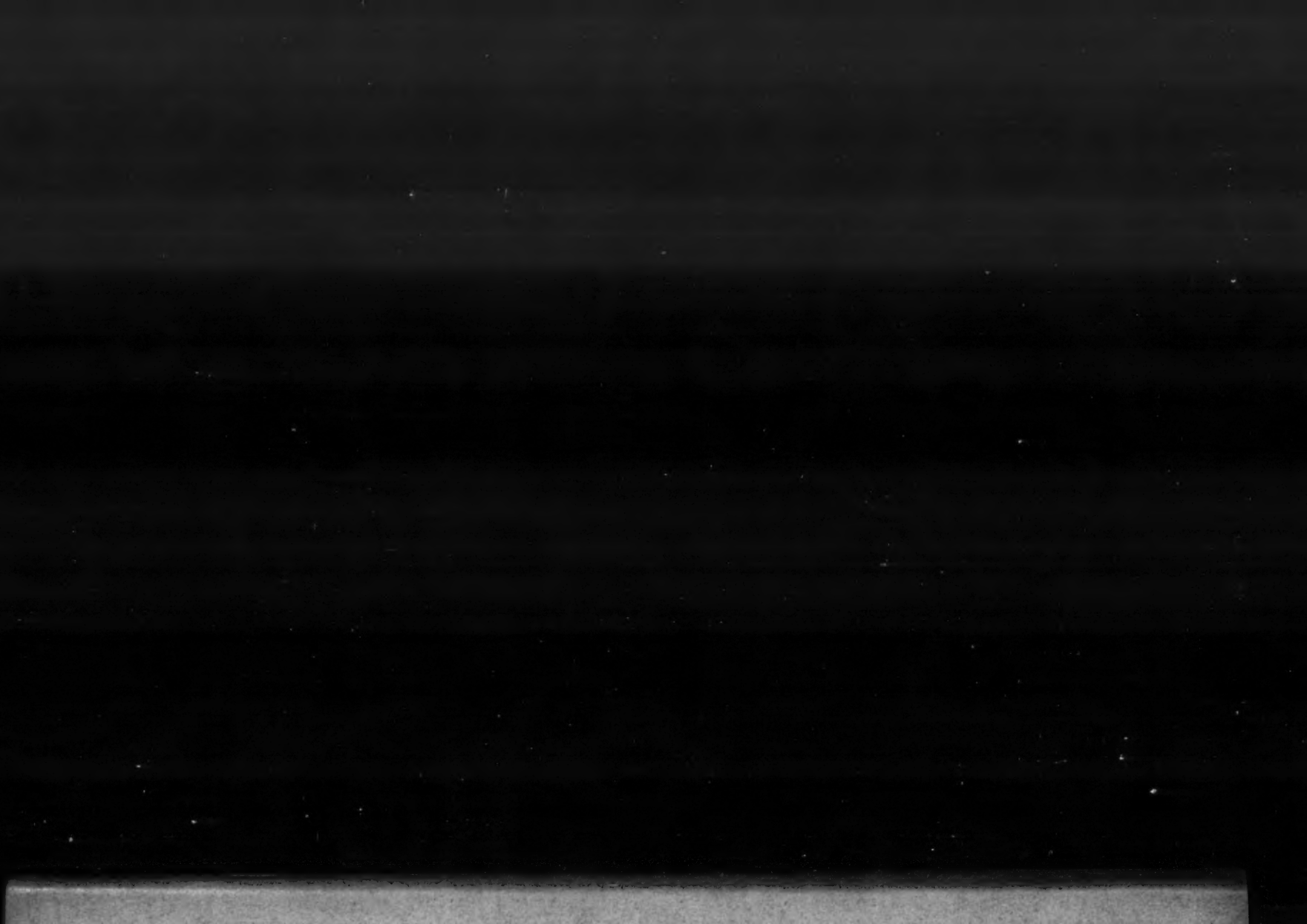
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